US009767163B2

(12) **United States Patent**
Kass et al.

(10) **Patent No.: US 9,767,163 B2**
(45) **Date of Patent: Sep. 19, 2017**

(54) **COMPUTERIZED TECHNICAL AUTHENTICATION AND GRADING SYSTEM FOR COLLECTIBLE OBJECTS**

(71) Applicants: **Stephen Brent Kass**, Los Angeles, CA (US); **Edward Korbel**, Sherman Oaks, CA (US); **Daniel R. Barbakow**, Los Angeles, CA (US); **Robert Alan Cook**, Encino, CA (US); **Hayden Blauzvern**, Austin, TX (US); **Megan Shao**, Torrance, CA (US); **Ben Teng**, Santa Clara, CA (US); **Avi Thaker**, Austin, TX (US)

(72) Inventors: **Stephen Brent Kass**, Los Angeles, CA (US); **Edward Korbel**, Sherman Oaks, CA (US); **Daniel R. Barbakow**, Los Angeles, CA (US); **Robert Alan Cook**, Encino, CA (US); **Hayden Blauzvern**, Austin, TX (US); **Megan Shao**, Torrance, CA (US); **Ben Teng**, Santa Clara, CA (US); **Avi Thaker**, Austin, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/000,989**

(22) Filed: **Jan. 19, 2016**

(65) **Prior Publication Data**

US 2016/0210734 A1 Jul. 21, 2016

Related U.S. Application Data

(60) Provisional application No. 62/104,606, filed on Jan. 16, 2015.

(51) **Int. Cl.**

G06T 7/00	(2017.01)
G06F 17/30	(2006.01)
G07D 7/20	(2016.01)

(52) **U.S. Cl.**

CPC ***G06F 17/3053*** (2013.01); ***G06F 17/30256*** (2013.01); ***G06T 7/001*** (2013.01); ***G07D 7/20*** (2013.01); *G06T 2207/30124* (2013.01); *G06T 2207/30176* (2013.01)

(58) **Field of Classification Search**

CPC H04N 1/3872; H04N 1/3875; H04N 1/387; G06T 5/001; G06T 11/60; G06T 3/0012; G06T 1/0078; G06K 9/3233; G06F 3/0484; G06F 3/04842

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,018,207	A	5/1991	Purdum	382/112
6,625,419	B2	9/2003	Ueno	434/350
2002/0076685	A1	6/2002	Ueno	434/350
2005/0197853	A1	9/2005	Ueno	705/1

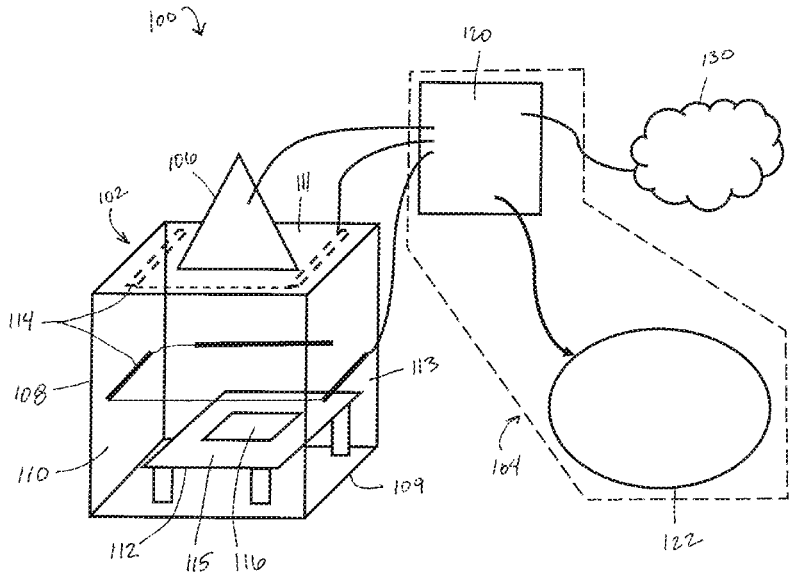
Primary Examiner — Duy M Dang

(74) *Attorney, Agent, or Firm* — Koppel, Patrick, Heybl & Philpott

(57) **ABSTRACT**

The disclosure described herein is directed to a computerized system and method of grading and authenticating collectibles utilizing digital imaging devices and processes to provide an objective, standardized, consistent high-resolution grading of collectible objects, such as but not limited to sport and non-sport trading cards. The disclosure eliminates the subjectivity present in the human grading process and overcomes the inherent limitations of the human eye.

32 Claims, 16 Drawing Sheets



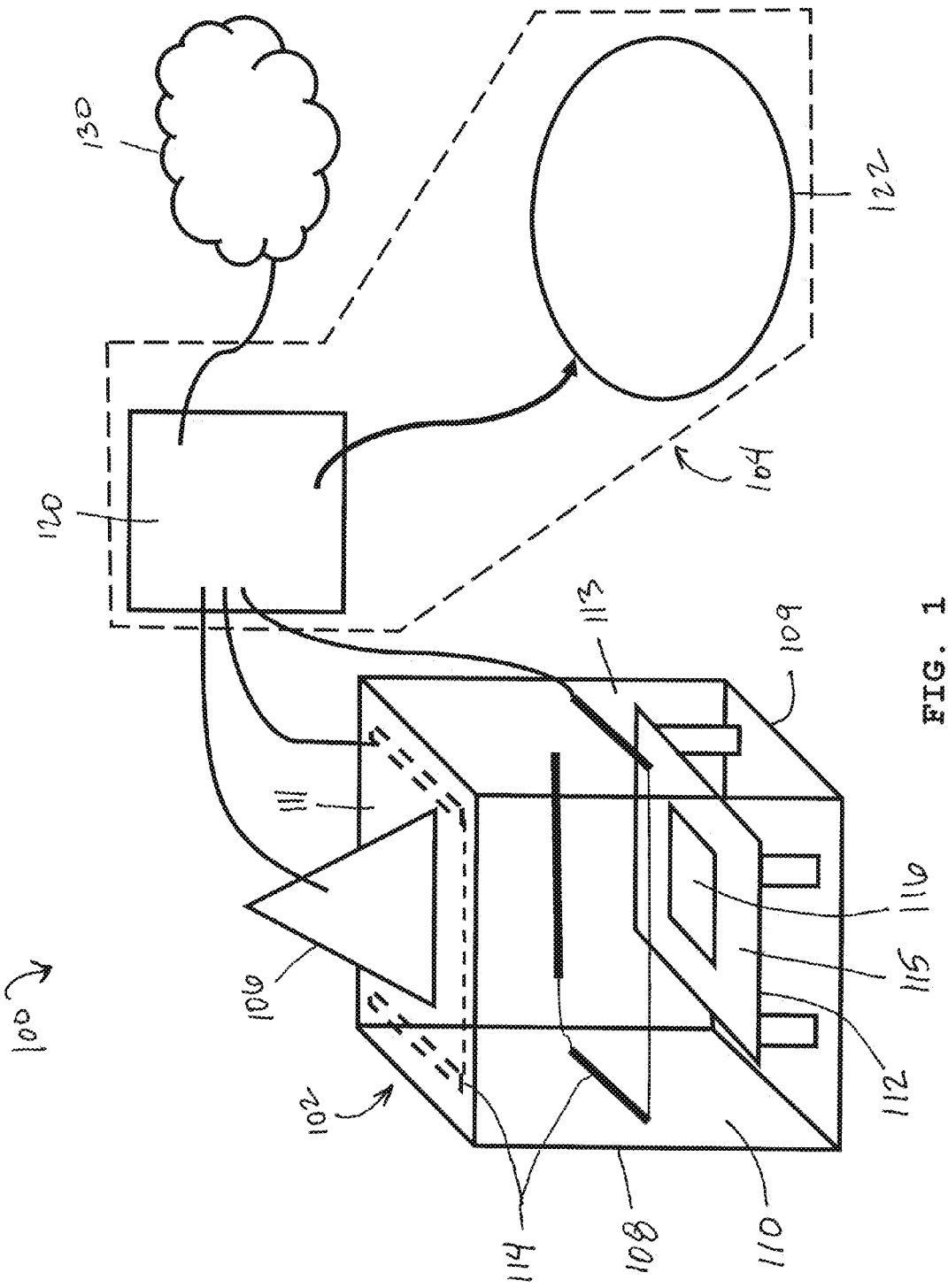


FIG. 1

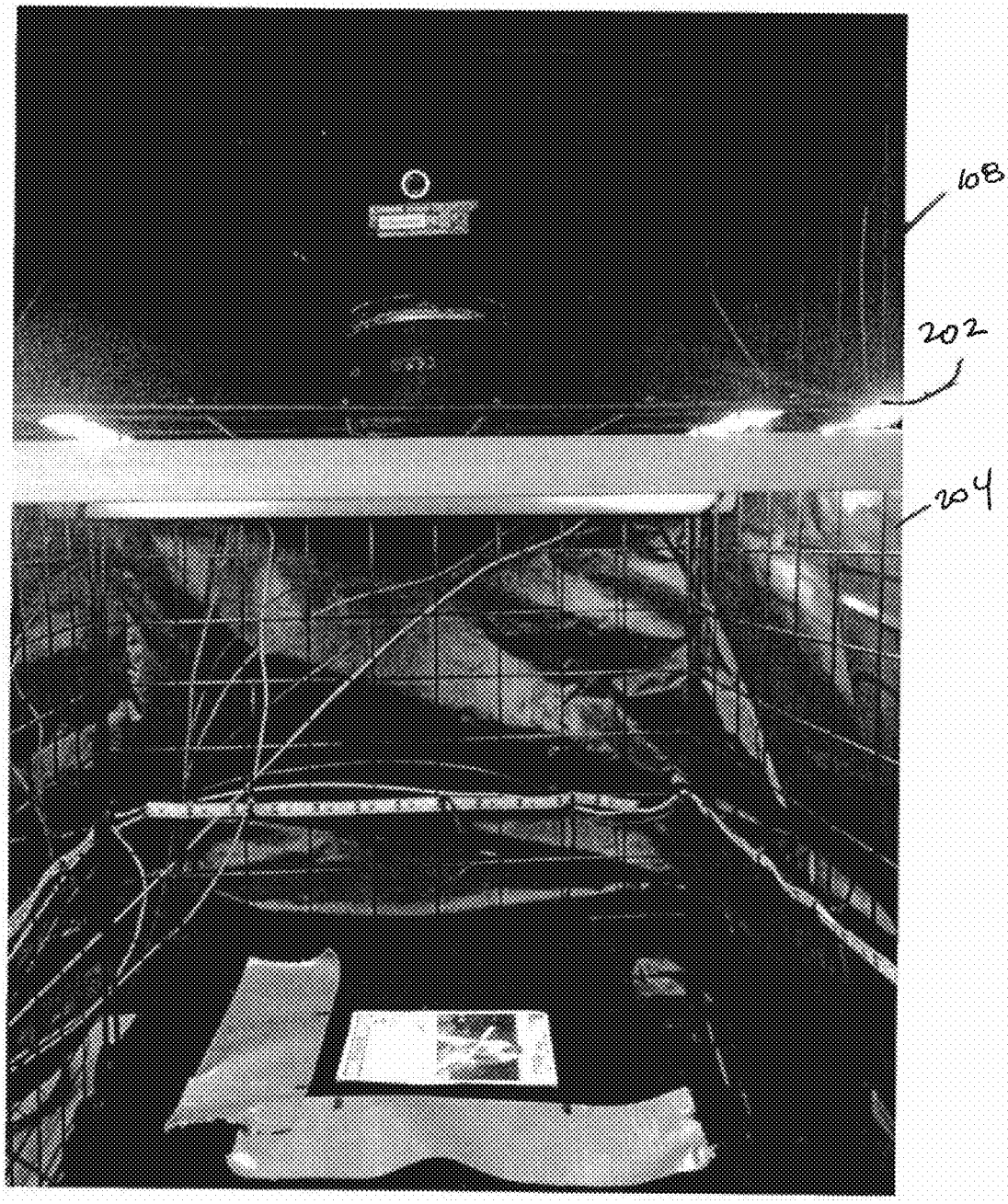


FIG. 2

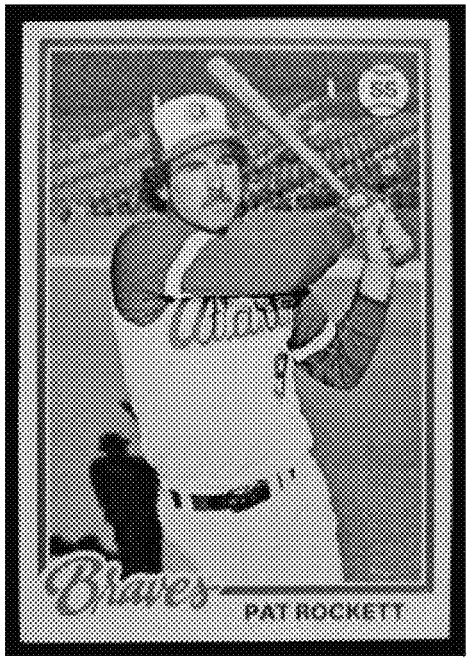
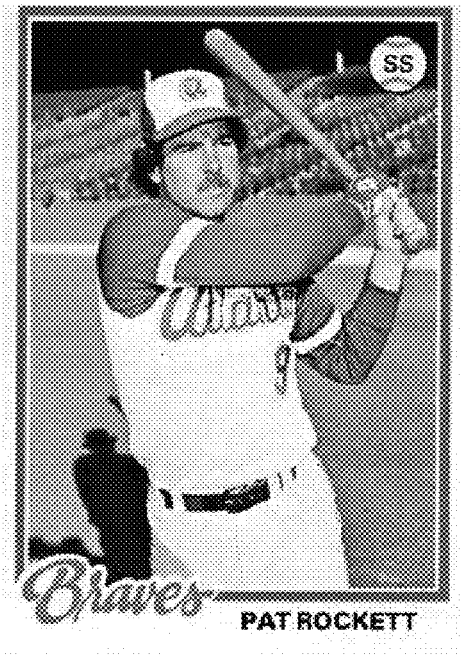
1978 Topps	
502	Pat Rockett
	
Score: 375	

FIG. 3

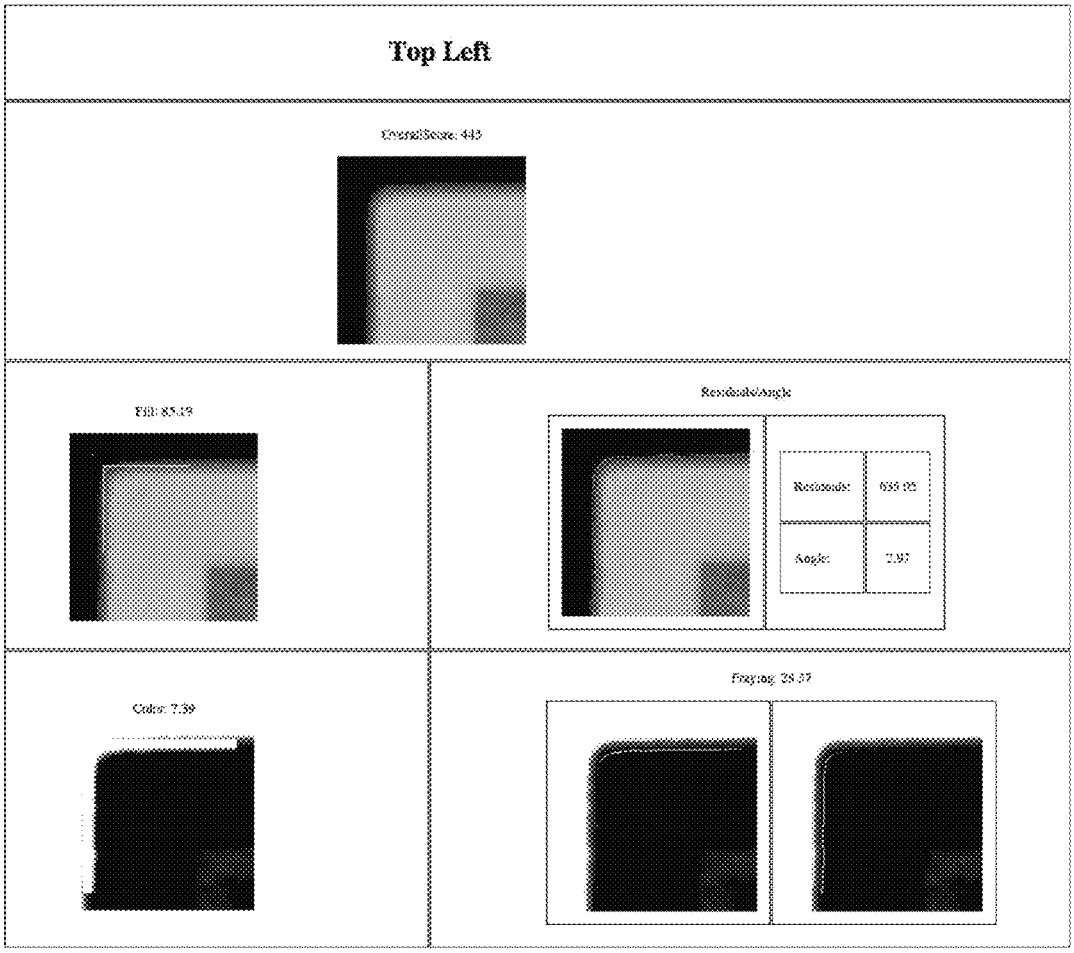


FIG. 4

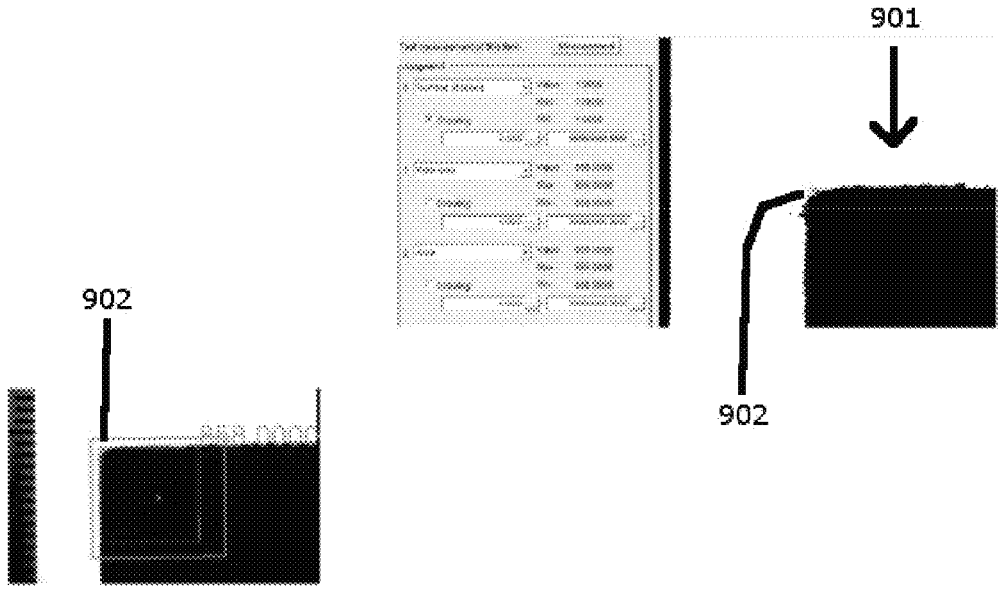


FIG. 5

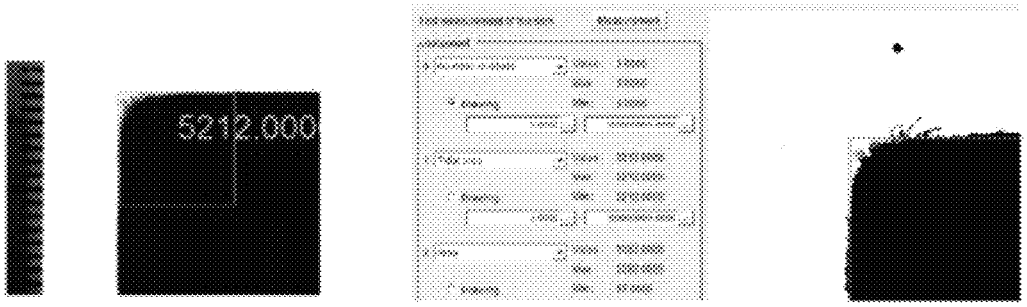


FIG. 6

Centering

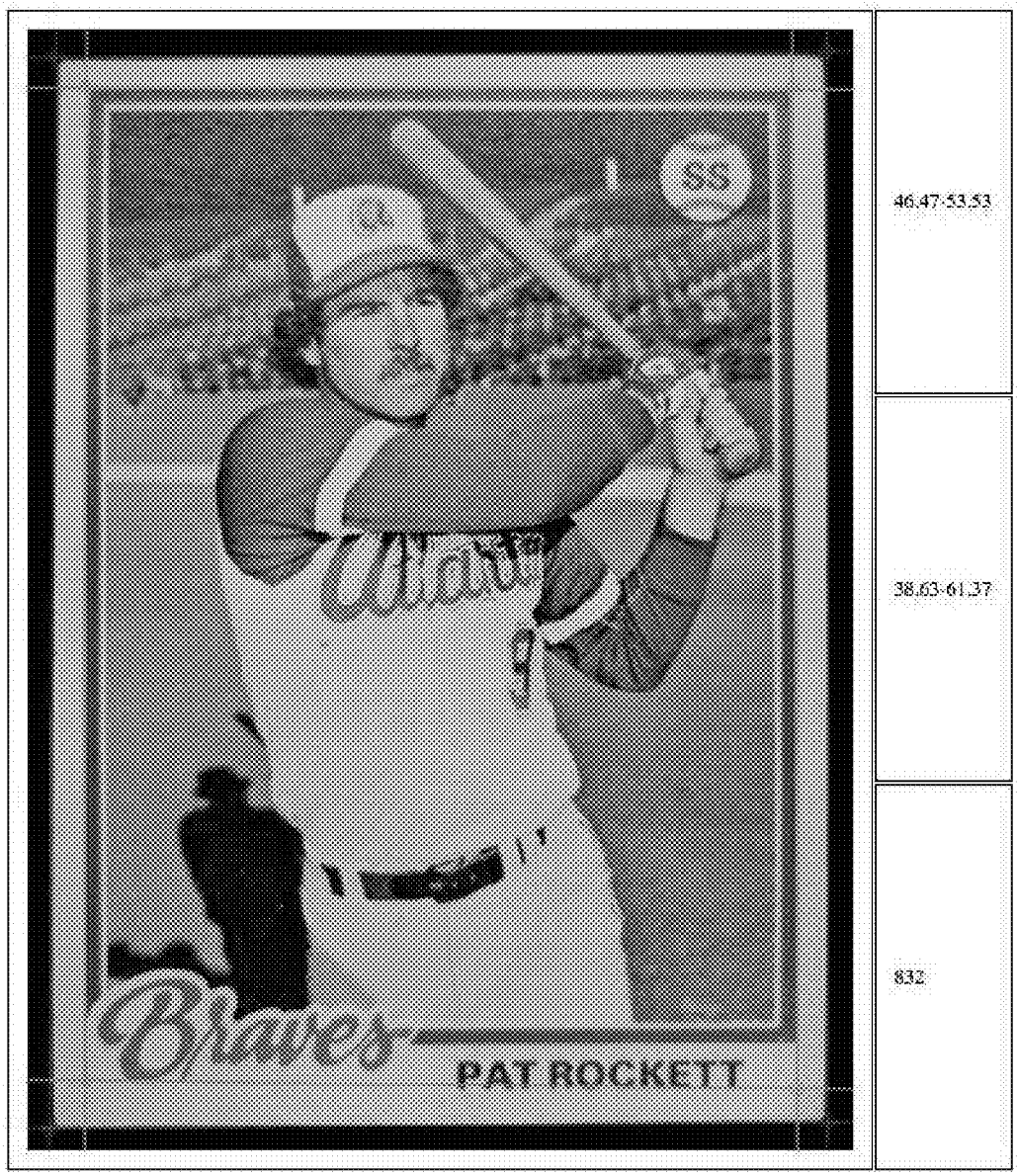


FIG. 7

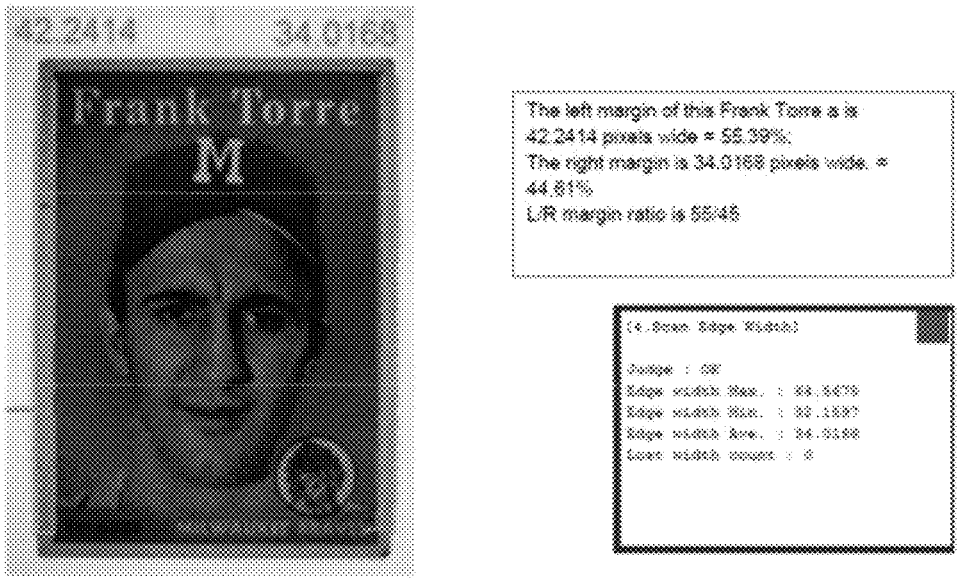

42.2414 34.0168
Frank Torre
M
The left margin of this Frank Torre a is
42.2414 pixels wide = 55.39%.
The right margin is 34.0168 pixels wide. =
44.61%
L/R margin ratio is 55:45

FIG. 8

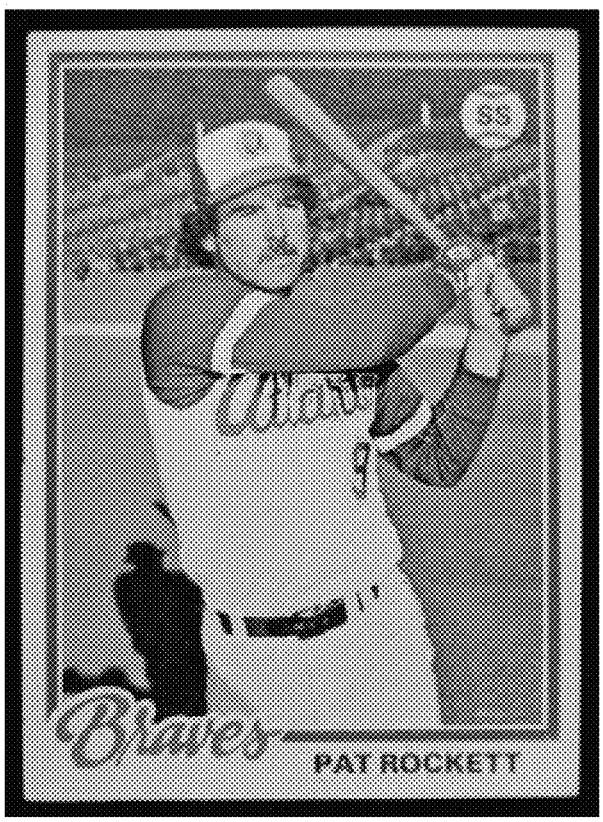
Edges		
Top: 813		
Left: 848		Right: 835
Bottom: 809		

FIG. 9

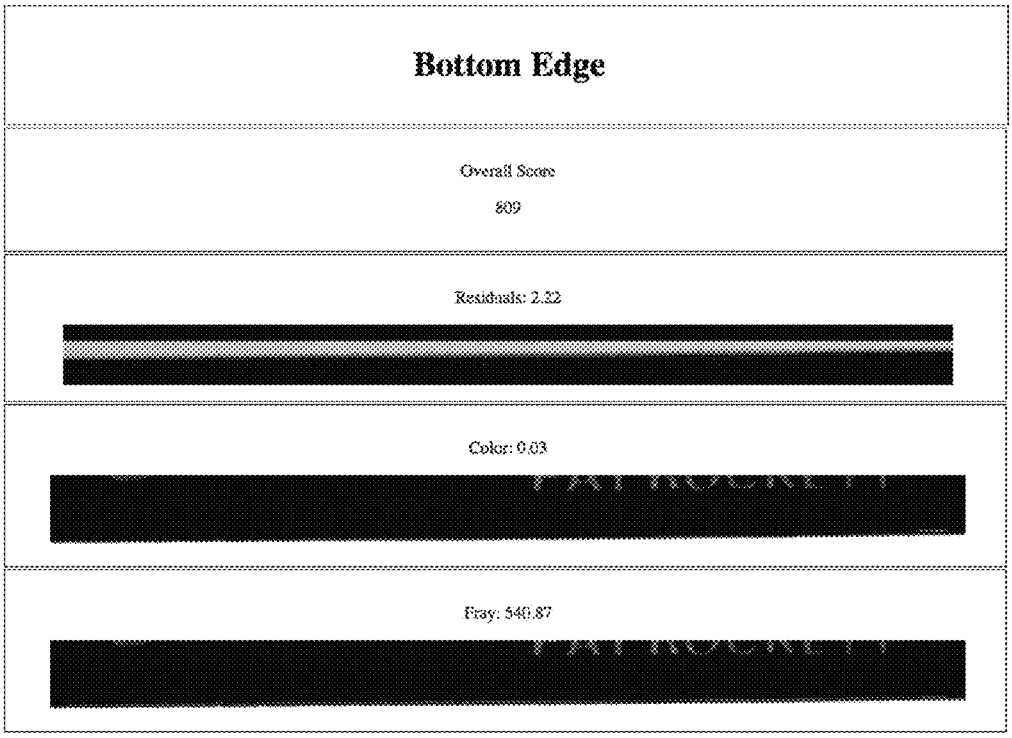

Bottom Edge
Overall Score
809
Residuals: 2.22
Color: 0.03
Fray: 540.87

FIG. 10

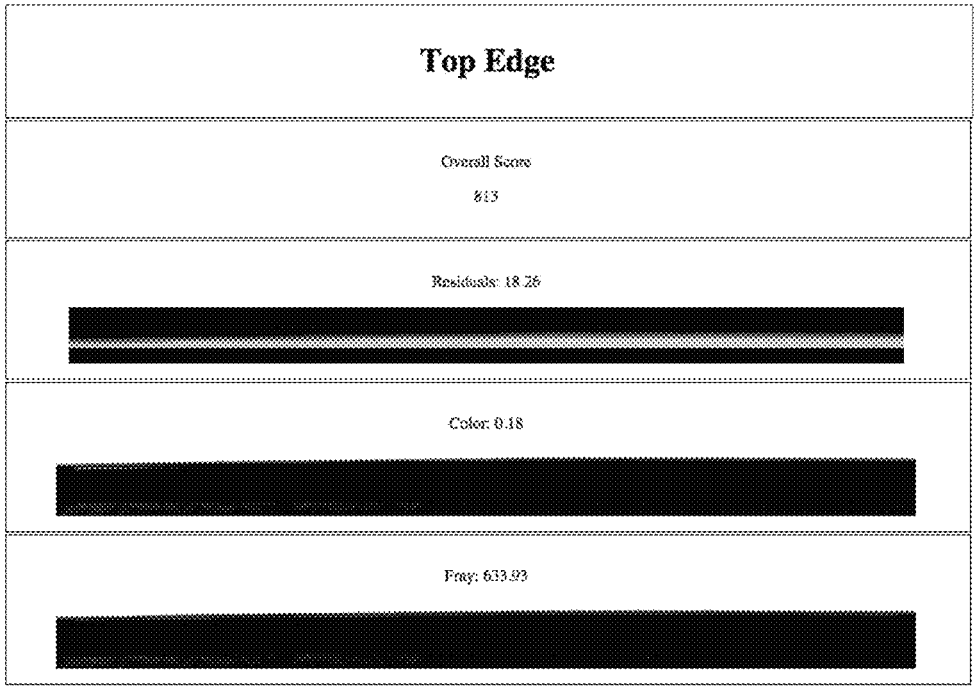

Top Edge
Overall Score
813
Residuals: 18.26
Color: 0.18
Fray: 633.93

FIG. 11

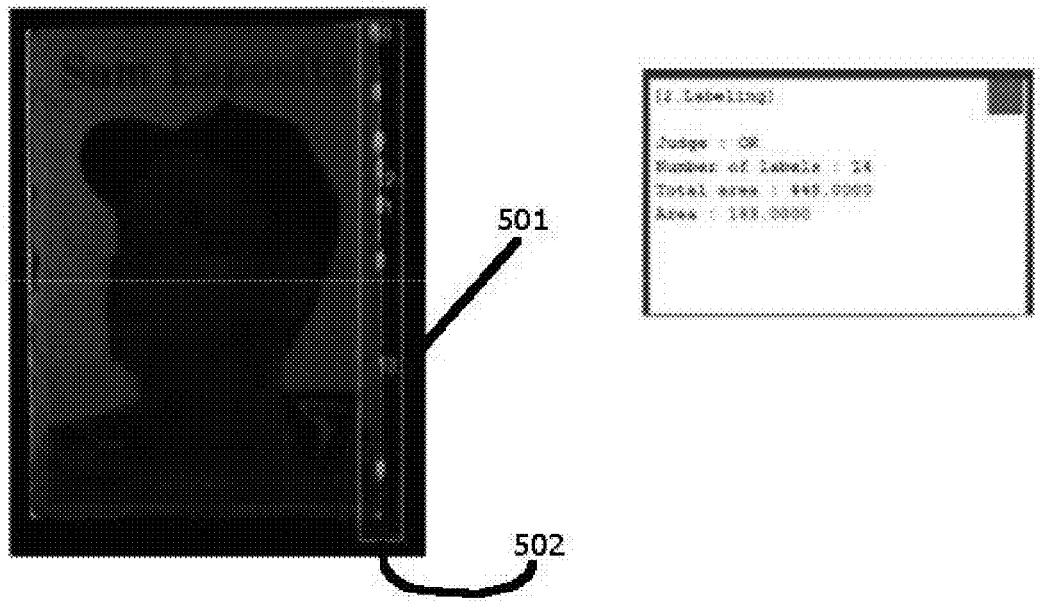


FIG. 12A

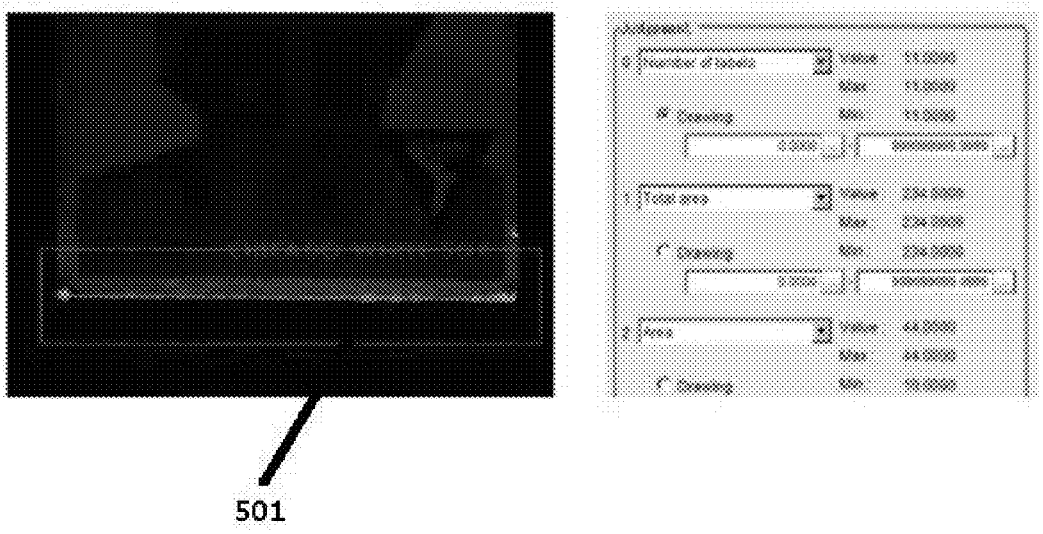


FIG. 12B

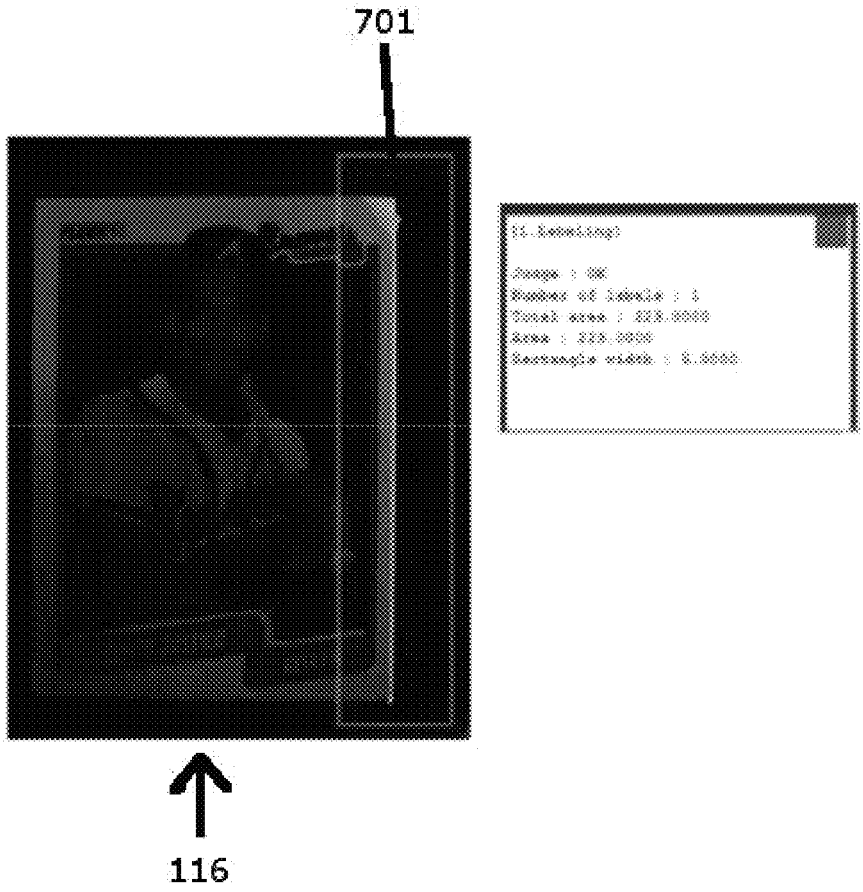


FIG. 13

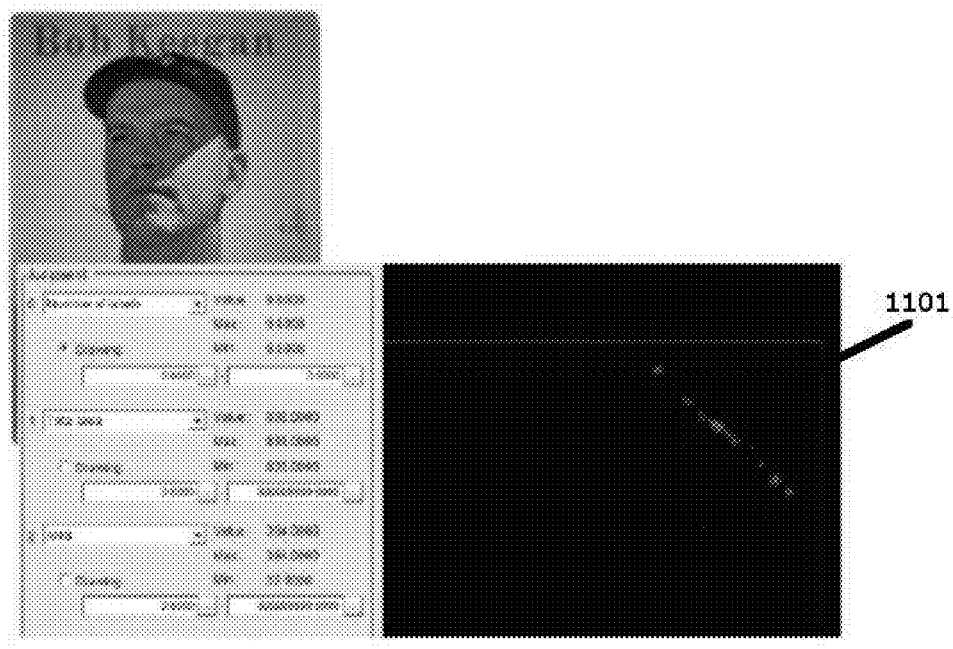


FIG. 14

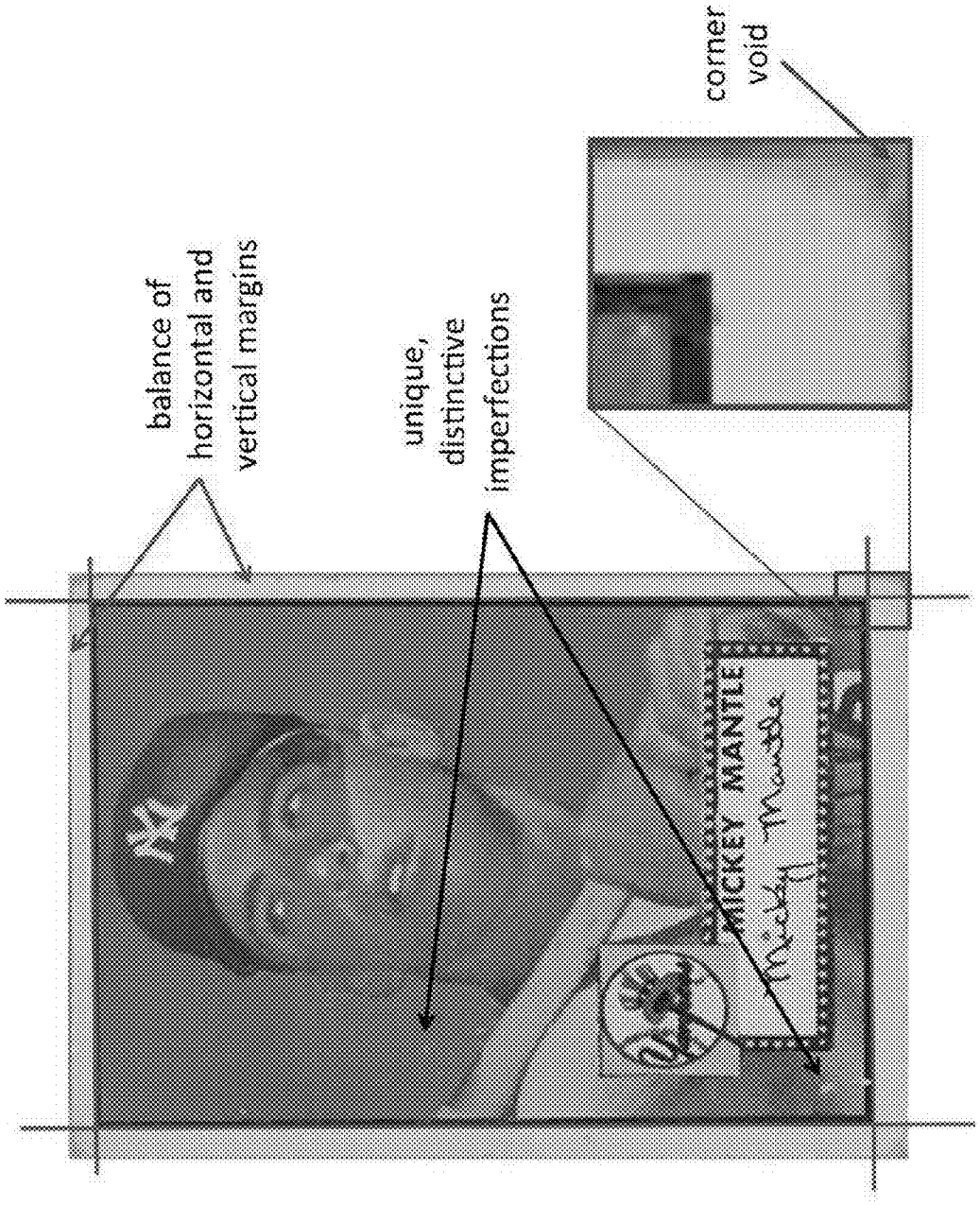


FIG. 15A

FIG. 15B

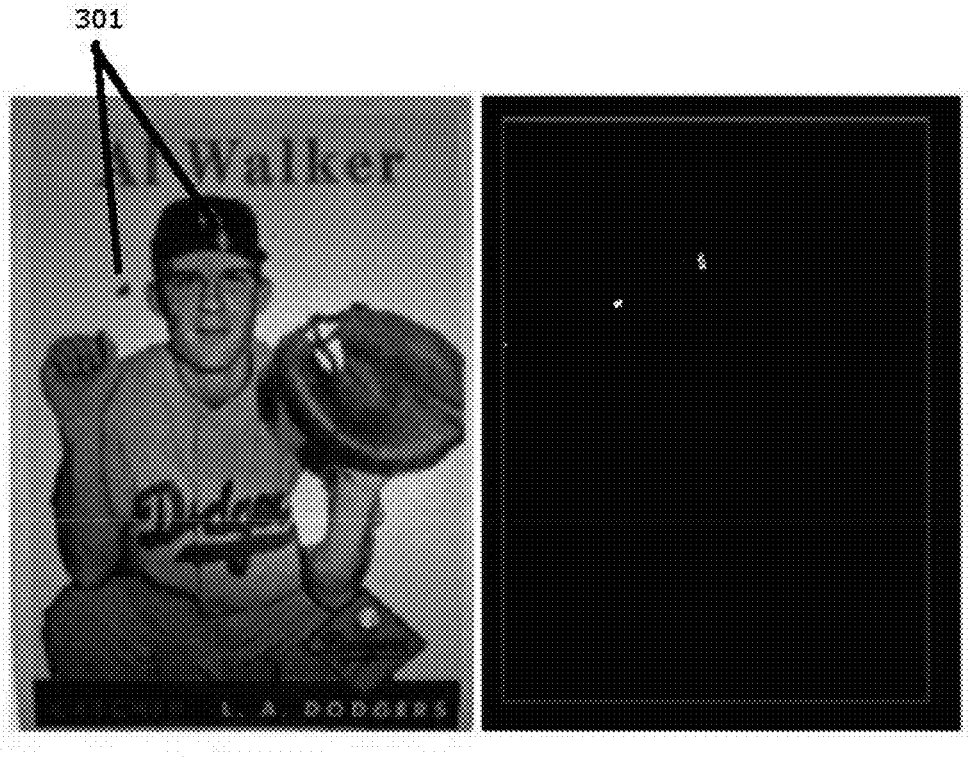


FIG. 16A

FIG. 16B

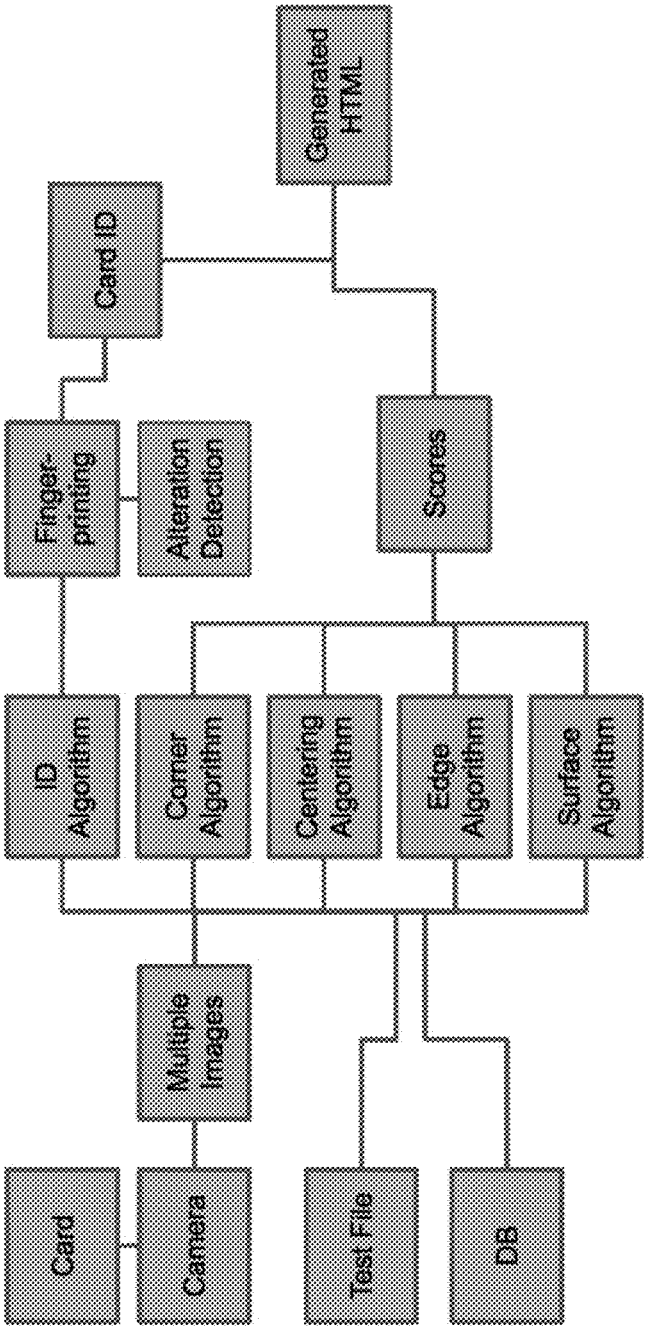

Generated HTML
Card ID
Finger-printing
Alteration Detection
Scores
ID Algorithm
Corner Algorithm
Centering Algorithm
Edge Algorithm
Surface Algorithm
Multiple Images
Card
Camera
Test File
DB

FIG. 17

COMPUTERIZED TECHNICAL AUTHENTICATION AND GRADING SYSTEM FOR COLLECTIBLE OBJECTS

RELATED APPLICATIONS

This application claims the benefit of priority under USC 119(e) to U.S. Provisional Application Ser. No. 62/104,606 to Stephen Kass et al., which was filed on Jan. 16, 2015. U.S. Provisional Application Ser. No. 62/104,606, including its drawings, schematics, diagrams and written description, is hereby incorporated in its entirety by reference.

BACKGROUND

Field

This disclosure generally relates to a grading and authenticating system and method of using the same. More particularly, the disclosure relates to a computerized system for grading and authenticating sport and non-sport card collectibles and other printed objects including event ticket, programs, photographs and the like.

Description of the Related Art

Card collecting, including sport and non-sport cards, has become, for many fans, much more than a hobby. There is a great deal of potential value in building a card collection and it could take years of research, time, and work. When a collector is interested in building a valuable card collection, it is very important for the collector to know that the condition of the card significantly affects its the value as a collectible. As such, it is very common for cards, as well as other collectible objects, to be professionally evaluated by industry recognized experts and graded in an effort to determine the value of a particular card or object. A professionally graded card is inspected for authenticity and rated on various criteria, for its condition. The card is then assigned an overall grade, generally from 1-10, sealed in a tamper-proof holder (slab) and assigned a certification number that is maintained by the grading company. A graded card can increase the value of the card in comparison to an ungraded card of equal or similar condition by means of offering the card owner or buyer an assurance of the card's authenticity and condition.

Grading cards is based on various characteristics that pertain to the "general eye appeal" of the card. Characteristics of the card that are universally examined in the grading process are centering, corners, edges, and surface. Centering is the placement of the image (top to bottom and left to right) on the card relative to the card borders. Industry standards exist for percentage of off centering variance permitted for each of the possible card grades. The corners of the card are inspected to determine the quality of the physical condition of the corner and/or if any defect of the corners is present. The edges of the card are examined, similarly as the corners, to determine the quality of the physical condition of the edges of the card, and account for any damages and/or imperfections along the edges. The surface of the card is examined to account for any damage and/or imperfections on the card, such as scratches, creases, tears, pinholes, stains, dents, attempts at recoloring, etc.

Today there are three industry accepted grading companies that represent approximately 99% of the market. Each of the grading companies grade cards by human evaluation, primarily with the naked eye and typically devote approximately one minute per card during the grading process. Because this grading process can be highly subjective, it results in cards rarely receiving the same grade when graded by any of the three industry leaders, or the same grade when re-graded with the same grading company that previously graded the card. As such, there is no grading methodology available in the marketplace today that provides accurate and consistent results in cards as well as other collectibles, e.g., coins, stamps, etc.

Grading is, with extremely rare exception, the most significant determination of value, such fluctuations in grading often result in misstatement of value and lack of confidence in the marketplace necessary to sustain a stable and efficient market. All of the grading companies solicit resubmission of any previously graded card in its original holder (slab) by other companies or even graded by themselves for the possibility of a higher grade.

Awareness in the marketplace of the possibilities for resubmitted cards receiving higher grades has resulted in card owners breaking open the "tamper proof" holders and resubmitting the cards multiple times, if necessary, without disclosing that the card has been previously graded.

The variance in grades for resubmitted cards combined with the subjective and inconsistent card grading process itself results in creating a lack of confidence in the marketplace necessary to sustain a stable and efficient market.

The present process utilized in the grading industry creates opportunity for larger collectors (e.g. larger customers of the card grading companies) to manipulate the current system's subjective grading to their advantage by re-submitting cards for a higher grade based upon natural human variability or their influence as a large customer. Small collectors lack sufficient size to "influence" card grading and often sell cards at lower prices due to the lower grades they receive.

Without an accurate and consistent grading system in place, there are no means of preventing grading companies and/or their larger customers from exploiting grading subjectivity and doing so at the expense of the small card buyer and seller. The "small" card buyer represents the overwhelming majority of card ownership but disproportionate minority of ownership of card value. This small collector is an entry-level hobbyist, for example, a young child who buys cards of his "hero" before the youngster becomes a collector.

The collectible market's dysfunction is facilitated by a lack of applying modern visual technology and computer processing capabilities. Grading today (by hand and by eye) while traditional, is unfair, inconsistent, and has high labor content, relative to the disclosure, which is directed to a computerized grading and authentication system and method.

The disclosure is a computerized system and method for objectively grading and authenticating collectibles. The disclosure is configured to objectively grade and authenticate collectibles at a higher reliability and consistency, by using a finer resolution than is possible with the human eye. The present disclosure addresses these needs and provides further related advantages.

SUMMARY

The disclosure provides various aspects of a computerized system and method for grading and authenticating collectibles, wherein the condition and quality of an image and the material upon which that image is placed, is a component of value as determined by the market. The disclosure provides a computerized system and method to objectively grade and authenticate collectibles. The disclosure eliminates the sub-

jectivity present in the human grading process and overcomes the inherent limitations of the human eye.

In one aspect of the disclosure, as broadly described herein, a computerized system is disclosed that grades and authenticates collectibles, comprising an image acquisition device and a computer system. The image acquisition device comprises a housing defining an internal space, an imaging device, at least one light source to illuminate at least part of the internal space, and a stage, wherein the stage is within the housing and receives a collectible. The computer system comprises at least one processor, and at least one output device, wherein the image acquisition device is configured to receive an input signal from the computer system. The image acquisition device is configured to transmit at least one output signal to the computer system. The at least one processor applies at least one image processing routine to the at least one output signal received from the image acquisition device such that the at least one processor produces grading information and transmits the grading information to the at least one output device.

In another aspect of the disclosure, as broadly described herein, a method for grading and authenticating collectibles comprising, capturing at least one image of a collectible, transmitting the at least one image to at least one processor, applying at least one image processing routine to the at least one image, producing grading information based on results of the at least one image processing routine, and transmitting the grading information to at least one output device.

This has outlined, rather broadly, the features and technical advantages of the disclosure in order that the detailed description that follows may be better understood. Additional features and advantages of the disclosure will be described below. It should be appreciated by those skilled in the art that this disclosure may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the teachings of the disclosure as set forth in the appended claims. The novel features, which are believed to be characteristic of the disclosure, both as to its organization and method of operation, together with further objects and advantages, will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of a computerized system according to an aspect of the disclosure.

FIG. **2** is a perspective view of an image acquisition device according to an aspect of the disclosure.

FIG. **3** is a view of part a grade report from the computerized systems according to an aspect of the disclosure.

FIG. **4** is a view of corner grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **5** is a partial view of a collectible and a partial view of corner grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **6** is a partial view of a collectible and a partial view of corner grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **7** is a view of a collectible and a partial view of centering grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **8** is a view of a collectible and a partial view of centering grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **9** is a view of a collectible and a partial view of edge grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **10** is a partial view of a bottom edge of a collectible and a partial view of edge grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **11** is a partial view of a top edge of a collectible and a partial view of edge grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **12**A is a view of a collectible and a partial view of edge grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **12**B is another partial view of edge grading scores of the collectible of FIG. **12**A.

FIG. **13** is a view of a collectible and a partial view of edge grading scores and corner grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **14** is a partial view of a collectible and a partial view of surface grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **15**A is a view of a collectible and a partial view of corner grading scores and surface grading scores of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **15**B is a partial view of the collectible of FIG. **15**A.

FIG. **16**A is a view a collectible and a partial view of surface grading of the grade report from the computerized systems according to an aspect of the disclosure.

FIG. **16**B is a partial view of surface grading of the collectible of FIG. **16**A.

FIG. **17** is a diagram of a computerized system according to an aspect of the disclosure.

DETAILED DESCRIPTION

The disclosure described herein is directed to different aspects of a computerized system and method for grading and authenticating collectibles, such as but not limited to sports cards, non-sports cards, coins, stamps, photographs, autographs and the like. The detailed description set forth below, in connection with the appended drawings, is intended as a description of various configurations and is not intended to represent the only configurations in which the concepts described herein may be practiced. The detailed description includes specific details for the purpose of providing a thorough understanding of the various concepts. It will be apparent, however, to those skilled in the art that these concepts may be practiced without these specific details. In some instances, well-known structures and components are shown in block diagram form in order to avoid obscuring such concepts. As described herein, the use of the

term "and/or" is intended to represent an "inclusive OR", and the use of the term "or" is intended to represent an "exclusive OR".

The disclosure uses an image acquisition device that can acquire one or more high resolution images of a collectible with detail that is at a higher resolution than that of the naked eye. The high resolution images of the collectible provide an enhanced degree of detailing of the collectible than is possible with the naked eye. The image acquisition device can also be configured to examine the physical condition and/or characteristics of the collectible to determine if the collectible has been altered and/or modified. The one or more high resolution images are processed using one or more image processing routines for the purpose of gathering all data applicable to making a determination of the authenticity, condition and grading of the collectible. Through the application of image processing, an analysis and evaluation of specific criteria can be provided resulting in a more consistent, repeatable, and objective grade for collectibles being established.

The disclosure can be utilized to obtain detailed information about the collectible that is not done currently with conventional human grading systems. For example, the detailed information obtained allows the disclosure to quantify the amount of any damage present in the collectible, if the collectible has been altered from its original condition, or if the collectible has been modified in an attempt to repair and/or conceal defects. These alterations and/or modifications can be imperceptible to the human eye and can result in the human grader assigning an inaccurate grade to the collectible, which thereby improperly inflates the value of the collectible. Furthermore, although it may be possible for the human grader to identify the presence of any damage in the collectible, the human grader cannot quantify the amount of such damage present in the collectible nor evaluate with a consistent standard from grading company to grading company, individual grader to individual grader, or card to card. Conventional human grading systems are outdated, inaccurate and distort the values of the collectible market.

Additionally, the lack of sophisticated grading systems creates the opportunity for the counterfeiting of collectibles. Counterfeiting is very prevalent in the collectibles marketplace and the disclosure can assist in detecting and thereby minimizing or even eliminating counterfeiting and/or fraud in the collectibles marketplace due, in part, to the elimination of the human element in the grading process.

Counterfeit cards can be fabricated in modern times that attempt to pass for originals. The quality of counterfeit cards has increased over time such that only a trained expert can identify a counterfeit. These trained experts are usually able to tell the difference of a counterfeit and an original. However, sometimes the counterfeit card is in the tamper-proof holder or slab and complete unobstructed access to the card is limited by the tamper-proof holder. In such instances, the trained expert may not be able to determine whether the card is a counterfeit or original. The disclosure utilizing high resolution images of the card within the tamper-proof holder can determine whether the card is counterfeit through the application of image processing and a comparative analysis of known genuine cards with a card being authenticated and graded by application of proprietary algorithms of the disclosure.

The disclosure is described herein with reference to certain aspects, but it is understood that the disclosure can be embodied in many different forms and should not be construed as limited to the aspects set forth herein. In particular, the disclosure is described herein in regards to a computerized system and method for grading and authenticating collectibles, but it is understood that the disclosure can evaluate and/or examine non-collectible items wherein authenticity and/or legitimacy of a non-collectible item is desired.

Although the terms first, second, etc. may be used herein to describe various elements or components, these elements or components should not be limited by these terms. These terms are only used to distinguish one element or component from another. Thus, a first element discussed herein could be termed a second element without departing from the teachings of the present application. It is understood that actual systems or fixtures embodying the disclosure can be arranged in many different ways with many more features and elements beyond what is shown in the figures.

It is to be understood that when an element or component is referred to as being "on" another element or component, it can be directly on the other element or intervening elements may also be present. Furthermore, relative terms such as "between", "within", "below", and similar terms, may be used herein to describe a relationship of one element or component to another. It is understood that these terms are intended to encompass different orientations of the disclosure in addition to the orientation depicted in the figures.

Aspects of the disclosure are described herein with reference to illustrations that are schematic illustrations. As such, the actual thickness of elements can be different, and variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances are expected. Thus, the elements illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the precise shape of a region of a device and are not intended to limit the scope of the disclosure.

FIG. **1** shows one aspect of a computerized system **100** according to the disclosure.

The computerized system **100** comprises an image acquisition device **102** and a computer system **104**. The image acquisition device **102** comprises an imaging device **106**, a housing **108** defining an internal space **110**, a stage **112**, and at least one light source **114** to illuminate at least part of the internal space **110**, wherein the stage **112** is within the housing **108** and receives a collectible **116**. The computer system **104** comprises at least one processor **120** comprising processor-executable computer instructions and at least one output device **122**, wherein the computer system **104** is configured to transmit one or more control signals to the image acquisition device **102**.

The housing **108** comprises a base **109**, a top **111**, and a plurality of sidewalls **113**, wherein the base **109** and top **111** are coupled to the plurality of sidewalls **113** such that the base **109** is opposite the top **111**. The base **109**, top **111** and plurality of sidewalls **113** define the internal space **110** of the housing **108**.

The stage **112** is disposed within the internal space **110** of the housing **108** and provides a support surface **115** to receive the collectible **116**. The positioning of the support surface **115** within the housing **108** is adjustable to any height within the internal space **110**. In some aspects, the support surface **115** can also be adjusted about one or more axes, such that the support surface **115** can be angled with respect to the imaging device **106**, at least one light source **114** or a combination thereof within the internal space **110**.

An imaging device **106** is adapted to capture at least one image of the collectible **116**. The at least one image of the collectible **116** captured by the imaging device **106** is a high resolution digital image of the collectible **116**. The high resolution digital image is a digital representation of the

collectible **116** and is processed using at least one image processing routine to determine a grade of the collectible **116** based on a set of technical grading criteria. In one aspect, the imaging device **106** can be a high resolution digital camera, such as but not limited to an 18 megapixel digital camera. However, the imaging device **106** is not intended to be limited to an 18 megapixel digital camera, and could have a resolution that is higher or lower than 18 megapixels. In addition, the imaging device **106** is not intended to be limited to a digital camera. When the imaging device used is a camera, the camera within the housing **108** is adjustable to any height within the internal space **110** to increase or decrease field of vision. In other aspects, the imaging device **106** can be a scanner or other imaging device that can create a digital image or other reproduction of the collectible **116**.

In aspects wherein the imaging device is a scanner, the scanner can be physically isolated from or replace and/or supplement the housing **108** and can have its own self-contained stage **112**, internal space **110**, at least one light source **114**, and a sensor to capture the image of the collectible on the surface. Such a scanner device is intended to be understood as an alternative or supplement in any description of the system herein. One example of a scanner can be a flatbed scanner. However, the scanner, or multiple scanners, can be arranged in many different known configurations, and is not intended to be limited to a flatbed-like scanner.

In aspects that utilize a digital camera as the imaging device, the collectible **116** is arranged on the surface **115** of the stage **112**, such that the collectible fills approximately 90% of the camera's field of view. With an 18 megapixel digital camera, for example, this results in approximately 1200 pixels of resolution per inch of a typical 3.5"×2.5" collectible card. A higher resolution camera would, in turn, yield a higher-resolution image. In other aspects, the collectible can be arranged to fill more or less than the camera's field of view and is not intended to be limited to 90%. This above 1200 pixels per inch is an example of what could be considered high resolution for any imaging device **106** of the image acquisition device **102**, and is not intended to be limited to aspects that utilize a digital camera. The above also applies to other imaging devices, such as but not limited to a scanner. The imaging device **106** can obtain an image of the collectible **116** in varying pixels of resolution per inch. For example, the pixels of resolution per inch can start from at least 300 pixels per inch and increase as desired. However, this example is not intended to be a baseline that needs to be met in order to qualify as high resolution. Images having 300 pixels per inch is generally accepted in digital photography as being high resolution images.

In one aspect, as shown in FIG. **1**, the imaging device or camera **106** is on the top **111** of the housing **108** and is positioned to face the collectible **116** on the support surface **115**, wherein the support surface **115** is proximate the bottom **109** of the housing **108**. The imaging device **106** can be removably coupled to the top **111**, while in other aspects, the imaging device **106** can be disposed on the top **111**. The housing **108** is configured to accommodate the imaging device **106** to allow the imaging device **106** to capture the at least one image of the collectible **116**.

For example, in the aspect of FIG. **1**, the top **111** of the housing **108** comprises an opening (not shown) that provides access to the internal space **110** of the housing **108** which allows the imaging device **106** to be on the housing **108**, external to the internal space **110**. The imaging device **106** is aligned with the opening of the top **111** in order to capture the at least one image of the collectible **116**. The imaging device **106** can comprise physical dimensions that are greater than the opening of the top **111** such that the imaging device **106** can be on portions of the top **111** beyond the opening.

However, in other aspects, the imaging device **106** can comprise physical dimensions that are less than or similar to the opening of the top **111**. The imaging device **106** can be configured to be externally disposed with respect to the internal space **110** of the housing **108** in order to capture the at least one image of the collectible **116**. In other aspects, part of the imaging device **106**, for example a lens body, at least partially extends into the internal space **110** of the housing **108** in order to capture the at least one image of the collectible **116**.

The housing **108** is configured to block penetration of exterior light into the internal space **110**, which prevents exterior light from altering the lighting condition of the internal space **110**. It is important to prevent and/or limit exterior light from entering the internal space **110** because exterior light could impinge on the collectible **116** and/or alter the pre-defined lighting condition, which could affect the accuracy of the grading of the collectible **116**. At least one advantage of the disclosure is that the grading of a collectible is repeatable with very accurate and consistent results. This is due, in part, to the high resolution images captured by the imaging device **106** under controlled pre-defined lighting conditions. However, in other aspects, exterior light may enter the internal space **110** of the housing **108** such that images captured by the imaging device **106** in the presence of exterior and/or uncontrolled light are acceptable for grading.

The housing **108** further comprises at least one light source **114** to illuminate at least part of the internal space **110**. The at least one light source **114** can be configured to provide a plurality of different lighting conditions, wherein the imaging device **106** captures an image of the collectible **116** under each of the different lighting conditions. The plurality of different lighting conditions accentuate the physical condition of the collectible **116** in order to detect defects and/or imperfections. For example, an indentation, scratch or crease on the collectible can cause a shadow under certain lighting conditions and the shadow can be examined to determine the extent of the indentation, scratch or crease. This is an example of the lighting conditions assisting in identifying a defect, and neither the invention nor the defects identified are intended to be limited to such examples.

The at least one light source **114** is positioned within the internal space **110** in order to provide the different lighting conditions. In the aspect of FIG. **1**, the housing **108** comprises a plurality of light sources **114** that are mounted to the sidewalls **113** and the top **111** (shown in phantom). The light sources **114** are positioned within the housing **108** with respect to the collectible **116** on the support surface **115** and are configured to emit light in response to a control signal transmitted from the computer system **104**. The control signal from the computer system **104** controls the on/off state of each of the light sources **114** in order to provide the different lighting conditions, wherein each of the plurality of different lighting conditions is a pre-defined lighting condition. The pre-defined lighting conditions allow collectibles **116** to be illuminated under the same set of lighting conditions that are constant and repeatable. Different pre-defined lighting conditions can be set for different types of collectibles. For example, the pre-defined lighting conditions for a baseball card may vary from the pre-defined lighting conditions of a stamp or coin.

In yet other aspects, as shown in FIG. **2**, the imaging device **106** can be within the internal space **110** of the housing **108**.

For the same or similar elements or features, the same reference numbers will be used throughout the application herein. In the aspect of FIG. **2**, the housing **108** comprises a support structure **202** interposed between the base **109** and the top **111** to receive the imaging device **106**. The support structure **202** provides support to the imaging device **106** such that the imaging device **106** is substantially stationary within the internal space **110**. The imaging device **106** is substantially stabilized within the housing **108** in order to capture the at least one image of the collectible **116**. The positioning of the support structure **202** can be adjusted to any height within the housing **108**. This allows the separation between the collectible **116** and support structure **202** to be varied as desired. In other aspects, the support structure **202** can also be adjusted about one or more axes, such that the support structure **202** can be angled within the internal space **110**.

The light sources **114** can comprise many different types of light sources, such as but not limited to, incandescent, fluorescent, light emitting diodes (LED), and the like, or a combination thereof. In the aspects of FIGS. **1** and **2**, the light sources **114** can comprise LED light strips that are electrically connected in either series or parallel. At least one advantage of using LEDs as a light source is that LEDs provide truer color information to the imaging device **106**. The LED light strips are connected to the computer system **104** and emit light in response to the control signal from the computer system **104**. In one aspect, the LED light strips are individually connected to the computer system **104** and have a dedicated control signal connection. This allows for better lighting control due in part to LEDs being more exact in terms of light emission. While in other aspects, the LED light strips are connected to the computer system **104** using a shared control signal connection.

The housing **108** can comprise many different materials and/or many different configurations. For example, in the aspect of FIG. **1**, the base **109**, the top **111**, and the sidewalls **113** of the housing **108** comprise solid construction material that substantially blocks exterior light. In other aspects, as shown in FIG. **2**, the housing **108** comprises a metal-wire scaffolding. The housing **108** of FIG. **2** does not, by itself, substantially block exterior light, and therefore further comprises a cover **204** that covers the housing **108**. The cover **204** can be a blackout curtain known in the art that are used to block light, or can be any other material, device or structure that blocks out exterior light. The cover **204** can also be used with the housing **108** of the aspect of FIG. **1** in an effort to further ensure that substantially all exterior light is blocked out and does not enter the housing **108**. Exterior light entering the internal space **110** could alter the lighting condition within the internal space that could result in an erroneous grading of the collectible. In other aspects, the housing **108** can comprise an access panel or other means for accessing the internal space **110**, such as but not limited to a hinged sidewall or part of a sidewall being hinged.

The disclosure is not intended to be limited to the configuration and/or the number of light sources **114** disclosed in the aspects of FIGS. **1** and **2**. The light sources **114** can be arranged in many different configurations within the housing **108**, and can comprise the same or different amount of light sources **114**. For example, in other aspects, the light sources **114** can only be on one or more sidewalls **113**, whereas in other aspects the light sources **114** can only be on the top.

The computer system **104** comprises at least one processor **120** and at least one output device **122**, wherein the computer system **104** is configured to transmit one or more control signals to the image acquisition device **102**. The one or more control signals provide instructions to each of the at least one light source **114** and the imaging device **106**. The computer system **104** transmits instructions via the control signal to the at least one light source **114** such that the at least one light source **114** provides a desired lighting condition in accordance with the instructions. The computer system **104** can also send a control signal to the imaging device **106** with instructions to capture an image of the collectible **116** after the at least one light source **114** is illuminating the collectible **116** under the desired lighting condition. The image acquisition device **102** thereby transmits an output signal to the computer system **104**, wherein the output signal comprises the captured image of the collectible. In one aspect, the image acquisition device **102** can transmit the output signal to the computer system along the same connection that the image acquisition device **102** received the control signal from the computer system **104**, while in other aspects, the output signal is transmitted from the image acquisition device **102** to the computer system **104** along a different connection. The connections between the image acquisition device **102** and the computer system **104** can be wired connections, wireless connections, or a combination thereof.

The computer system **104** can be configured to run a script comprising a series of instructions for the imaging device **106** and the light sources **114**. For example, in one aspect, the script can comprise a sequence of actions wherein a series of control signals are transmitted to the imaging device or digital camera **106** and the light sources **114** such that the on/off state of one or more of the light sources **114** is activated/deactivated to provide one of a series of predefined lighting conditions, wherein the imaging device or digital camera **106** captures an image of the collectible **116** illuminated, if needed, in each one of the series of predefined lighting conditions, such that after each image is captured, the imaging device **106** transmits the captured image to the computer system **104**, and the computer system **104** labels the image using metadata, exchangeable image file format (exif), and the like, and/or by naming the image filename to indicate the lighting condition under which the image was taken. This process repeats until an image has been captured under each of the series of pre-defined lighting conditions. The collectible **116** is stationary on the surface **115** and its positioning is not altered while the series of instructions are implemented by the light sources **114** and the imaging device **106**. This results in each of the captured images being substantially aligned while illuminated under the different lighting conditions.

In one aspect, there can be nine different lighting conditions in which an image of the collectible **116** is to be captured. This will result in a set of seven to nine images of the collectible **116** in the seven to nine different lighting conditions. These images will then be processed and analyzed by the computer system **104** to determine a grade for the collectible **116**. The disclosure is not intended to be limited to only seven to nine different lighting conditions. The disclosure can comprise more or less than seven to nine light different lighting conditions resulting in any number of images of the collectible.

In some aspects, the different lighting conditions can be provided by activating one of the light sources **114** and deactivating the remaining light sources **114**, and repeats until each of the light sources has been activated individually. The number of captured images of the collectible **116**

in different lighting conditions can be proportional to the number of light sources **114**, or can be independent of the number of light sources **114**. In other aspects, the different lighting conditions can be provided by activating a plurality of the light sources **114** and deactivating the remaining light sources **114**. In such aspects, the intensity of light emission of the plurality of light sources **114** that are activated can be equivalent or different.

After the series of instructions has been completed, the collectible **116** can be repositioned, either automatically or manually, in order to capture images of another side of the collectible **116** utilizing the same and/or different series of instructions. For example, a collectible **116**, such as but not limited to a baseball card, has a front side and a back side, such that when all the images of the front side have been captured, the baseball card can be automatically or manually turned over on the surface **115** to capture images of the back side. The lighting conditions for the back side of the card can be the same or different than the front side. For example, one side of the card can be glossy while the other side is not, such that different lighting conditions may be needed to give a proper grade. In one aspect, images of both the front and back sides of the baseball card under the different lighting conditions can be taken for the purpose of grading the baseball card. However, in other aspects, images of only one side of the baseball card can be taken for the purpose of grading the baseball card. In yet other aspects, the collectible **116** can comprise a plurality of sides, wherein images of each of the plurality of sides can be captured in the different lighting conditions for the purpose of grading the collectible **116**. However, in other aspects, images of at least one of the plurality of sides can be captured in the different lighting conditions for the purpose of grading the collectible **116**. The collectible **116** can be repositioned manually to expose another side, while in other aspects, the repositioning of the collectible **116** could be automated. In yet other aspects, the image acquisition device **102** can comprise a plurality of imaging devices **106**, such that the image acquisition device **102** can capture images of the top and bottom sides of the collectible **116** simultaneously, or without having to turn over the collectible to capture images of another side of the collectible. In such aspects, the collectible **116** can be interposed between the plurality of imaging devices **106**.

Upon completion of the series of instructions, the computer system **104** will have a single or a plurality of images of the collectible **116**, wherein each image is a high resolution image of at least a portion of the entire surface of the collectible **116** illuminated in a different lighting condition. Each image are labeled by the computer system **104** to identify the lighting condition it was taken. The images can be stored on an internal storage device of the computer system **104** or can be stored on an external storage device that is accessible by the computer system **104**. The images will then be processed and analyzed under one or more image processing routines. In one aspect, after the computer system **104** receives the images from the image acquisition device **102**, or from an image source external to the image acquisition device, the computer system **104** applies at least one image processing routine wherein the images are substantially aligned such that all the images are in substantially the same orientation and/or dimensions as each image in the database and with each future image created for grading. This allows for images to be overlaid and assist in the image processing. In some aspects, the system **100** comprises one or more collectible image sources and creates and stores one or more images of the respective collectible **116**, wherein multiple collectibles **116** can be graded concurrently from each image source. For example, the system **100** can comprise a plurality of image acquisition devices **102** and/or configured to receive at least one external signal comprising an image of a collectible. This allows the system **100** to grade multiple collectibles **116** and operate in an efficient manner.

For a firmware and/or software implementation, the methodologies may be implemented with modules (e.g., procedures, functions, routines and so on) that perform the functions described herein. A machine-readable medium tangibly embodying instructions may be used in implementing the methodologies described herein. For example, software codes may be stored in a memory and executed by a processor unit. Memory may be implemented within the processor unit or external to the processor unit. As used herein, the term "memory" refers to types of long term, short term, volatile, nonvolatile, or other memory and is not to be limited to a particular type of memory or number of memories, or type of media upon which memory is stored.

If implemented in firmware and/or software, the functions may be stored as one or more instructions or code on a computer-readable medium. Examples include computer-readable media encoded with a data structure and computer-readable media encoded with a computer program. Computer-readable media includes physical computer storage media. A storage medium may be an available medium that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can include RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage, solid state or other magnetic storage devices, or other medium that can be used to store desired program code in the form of instructions or data structures and that can be accessed by a computer; disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

In addition to storage on computer readable medium, instructions and/or data may be provided as signals on transmission media included in a communication apparatus. For example, a communication apparatus may include a transceiver having signals indicative of instructions and data. The instructions and data are configured to cause one or more processors to implement the functions outlined in the claims.

In one aspect, the computerized system **100** is configured to objectively grade collectibles **116**, such as but not limited to baseball cards, according to a set of technical grading criteria (see listing of Table 1). The methodology for detecting defects in a collectible **116** comprises the collectible **116** being examined for variations of each criteria with respect to a perfect reference image or Golden Image stored in a database **130**.

TABLE 1

Number	Category	Criteria
1.	Overall Subject Eye Appeal	Color Centering Stains Scratching Creasing Printing errors Shape

TABLE 1-continued

Number	Category	Criteria
	Size of Subject	Length (permitted variance to allow for inexact cutting older subjects)
	Diameter	Width (permitted variance to allow for inexact cutting older subjects)
	Thickness of Subject	Consistency (has part or whole of subject been pressed)
	Identification of Subject	Year of set (manufacture)
		Name of Manufacturer
		Player or person name
		Player or person status (R, HOF, error Subject)
		Subject number
		Subject owner
		Subject registration number or file number
		Subject detail grading specifics for point reductions
	Inconsistencies	Specific alerts color
		Specific alerts borders
		Mis-cut (length and width)
2.	Corners	Angle, Residual, Fray and Fill
		Hanging fiber
		Dents
		Chips
		Folds
		Crease
		Scratches
		Trimming
		Bleaching
		Added material
		Added Coloring
		Pressing
		Moistening
		Gluing
3.	Subject Surface	Gloss
		Color (including no added color)
		Borders (including no bleaching or cutting)
		Misprinting/print defects
		Mis-cut
		Creases
		Cracks
		Folds
		Chips
		Scratches
		Pin holes
		Tape and other stains
		Tears
		Variations from Golden Image
		Known Counterfeit Defects
4.	Centering	Front of subject: Left/Right
		Front of subject: Top/Bottom
		Back of subject: Left/Right
		Back of subject: Top/Bottom
		Image skew
5.	Subject Back	Stains
		Print errors
		Dents
		Chips
		Folds
		Creases
		Scratches
		Variations from Golden Image
		Pin holes
		Tape and other stains
		Tears
6.	Edges	Cutting razor marks
		Cutting and no hanging fiber
		Cutting resulting whiteness
		Cutting and resulting subject dimensions
		Laser cutting
		Laser cutting and no hanging fibers
		Laser cutting resulting subject dimensions
		Signs of pressing
		Signs of adding material
		Signs of bleaching (centering)
		Signs of coloring
		Gluing
		Moisture
		Stretching
		Shrinking
		Peaks & Valleys
		Fraying
		Sanding or filing
		Pressing
		Polishing

A Golden image **117** for a collectible **116**, i.e., perfect image without any unintended defects included by its originator, may be created in the following manners: (1) An image of the collectible **116** in its original format ("Original Golden Image") is supplied by its creator and entered into the computerized system **100** and stored in a file (the "Image Library") in a tangible computer memory medium, such as the database **130**; (2) a Golden Image is created by altering and enhancing a collectible **116** image ("Virtual Golden Image") by removing all detectable defects unintended by its originator through the use of image processing and storing the newly created Virtual Golden image in a "Golden Image Library" in a tangible computer memory medium, for example, in a data structure, such as the database **130**; (3) the highest graded card graded by the system **100** becomes the de facto Golden image until a higher graded card is found; or (4) by using machine learning, assembling perfect portions of other copies of the same card contained within the database. In aspects where the golden image for a collectible is not available, the system can use the highest graded card as the defacto golden image. Subsequent grading of similar cards with higher grades can become the new golden image. The system **100** might not know what defects were unintended or get an original image from the creator to have a golden image. As such the system **100** is configured to create a golden image by using the highest graded card. In other aspects, the system **100** can create a golden image by taking portions of different graded cards that are highly graded and combine them with other high graded portions to form a golden image.

Machine learning maps visual features to an overall card grade that is accurate and consistent beyond what human graders can provide. In one aspect, a machine-learning algorithm, known as k-nearest neighbors, combines the values of measured attributes into a single score for the portion of the card or collectible being evaluated. In one aspect, the k value for the nearest neighbors can be 11, such that the eleven nearest neighbors are used. However, other k values for the nearest neighbor can be used and the disclosure is not intended to be limited to a value of 11 for k. In an example of obtaining a corner score for a card using machine learning, the corner algorithm can examine a number of attributes, such as, for example, 4 attributes, and derive individual corner scores for each of the four corners. From those four individual corner scores, the overall card corner score is computed. The fundamental computation of a single corner score is derived from individual corner scores for each of the four corners using a proprietary algorithm to weight the four corner scores to arrive at the single corner score. A weighting of the four corner scores may include a small increase in the minimum value in certain situations, such as, when the lowest scored corner is significantly different from the other three corners, or when

the overall card grade will not be above a pre-established threshold grade (on a 10 point scale). The increase can be 0.25 point, but can be set at other values. The result is the overall card corner score that can be expressed on a 1000 point scale (that is, with a resolution of 1/1000). The card corner score can also be expressed with the same relative resolution on a 10 point scale. The machine learning algorithms can be further refined by input from trained professional human graders.

The database **130** comprises a datastore of known collectibles, such as but not limited to baseball cards. The database **130** comprises as many images of collectible as possible, and grows as additional images are added. The database **130** can also grow as the computerized system **100** is used to grade collectibles. Along with each image, a set of metadata is stored, which can comprise information about the collectible or baseball card **116**, such as but not limited to: manufacturer of the card; year of the card's manufacturing; series name of the card; name of player or person on the card; the card number; any variation particular to that card series, e.g. red-black or gray-black; any ownership information available; any distinctive features or other information unique to that particular card, e.g., distinctions such as, but not limited to, Hall of Fame, Rookie, traded, high number, limited production, etc.; geometric information about where the inner-image appears within the cardstock or value-altering variations, e.g., autographs on the card. This set of metadata is described in relation to baseball cards, but the metadata is not intended to be limited to baseball cards. Metadata of other types of collectibles can also be collected. The computerized system **100** can be configured to allow the addition of any grading-specific information into the computer system **104** in order to facilitate faster processing or specific tasks. For instance, the computer system **104** could receive a test file comprising a set of initial perceptual hashes, which would speed the matching of a newly-imaged collectible or card **116** to the known cards of the database **130**. Alternatively, it might include information about the owner of the currently-imaged card or collectible **116**, wherein the database **130** options can then be filtered by that information and the best-match of only that owner could be found.

In one aspect, a comparison between the image of the collectible **116** and the Golden image **117** is conducted by the computer system **104**. The image of the collectible **116** is first obtained and identified, as discussed above, by the computer system **104**, and the Golden image **117** corresponding to the collectible **116** is retrieved from the Golden Image Library stored on the database **130**. After the Golden image **117** for the collectible **116** is retrieved, one or more image processing routines are applied to the image of the collectible **116** for the purpose of gathering all data applicable to making a determination of the authenticity, condition and grading of the collectible **116**. An example of an image processing routine utilized is a card identification algorithm. The card-ID algorithm takes as input the image of the collectible or card **116** and outputs the identity of the card, if there is a match available in the database **130**. If there is no match, the algorithm issues alert to indicate that this is the first time this specific collectible or card **116** has been seen and a prior image does not yet exist in the image database. In this case, information about the card (manufacturer, etc.) can be manually inputted into the database **130**, and that information along with the image of the collectible or card **116** will be added to the database **130**. The card-ID algorithm distills all of the captured images of the collectible or card **116** into the database **130** in 64-bit perceptual hashes, as known in the art.

When the system **104** receives a newly-obtained image of a collectible or card **116**, its 64-bit perceptual hash is also computed. Then, the perceptual hash of the newly-obtained image is compared to all of the known hashes from the database **130**. The top **200** closest matches are then considered, one-by-one, and the collectible's or card's 116 pixels are directly compared to the images in the database **130** using a template matching process, such as but not limited to OpenCV's template-matching. The best of those template-matched images, if within a threshold, is declared the correct match or archived, if running in batch mode. If none of the images matches within the threshold, the system **104** declares that no match was found. The system **104** is not intended to be limited to computing 64-bit perceptual hashes of the images. In some aspects, the system **104** can compute perceptual hashes of varying sizes, higher or lower than 64-bit, such as but not limited to, 128-bit, 256-bit, etc. In some aspects, the system **104** can utilize various hash functions and is not intended to be limited to perceptual hash functions.

Table 1 identifies various specific criteria that may be examined by the image processing methods of the disclosure, in any combination, using six broad categories of criteria. Through the use of thresholds and algorithms, collectible **116** data is collected and applied to four condensed categories (Front and Back): (1) Corners; (2) Edges; (3) Surface; and (4) Centering. Within each category, as well as for general eye appeal, many image processing methods/algorithms may be utilized so that, for example, 72 or more criteria may be evaluated and analyzed for each collectible **116**.

After all the images are collected and processed, 50 separate raw data scores of 1-1,000 are determined for each card—25 for the front side and 25 for the back side, thereby giving a total maximum raw card score of 50,000. The raw scores can be collected for the front and back as follows: 16 raw corner scores comprised of scores up to a maximum of 1,000 each for Fray, Fill, Residual and Angle (these terms to be defined within), thereby a maximum "Raw" score of 4,000 for each of the four corners for a total of 16,000 for corners; 4 Centering (defined herein) scores up to a maximum of 1,000 each for—top, bottom, left, right, thereby a maximum total raw score of 4,000 for centering; 4 Edge (defined herein) scores—up to a maximum raw score of 1,000 each for top, bottom, left, right thereby a maximum total raw Edge score of 4,000 for edges; 1 Surface score (defined herein)—combining the data from all surface defects for maximum raw Surface score of 1,000 for surface. This provides a possible maximum total raw score of 25,000 each for front and back of the card.

The 25 raw scores for front and back are processed by proprietary algorithms to arrive at 11 attribute scores, for each of the front and back of the collectible, up to a maximum of 1,000 each for front and back: 4 attribute Corner Scores up to a maximum attribute score of 4,000; 2 attribute Centering Scores, for top/bottom and left/right, up to a maximum attribute score of 2,000; 4 attribute Edge Scores, for top, bottom, left and right, up to a maximum attribute score of 4,000; and 1 attribute Surface Score up to a maximum attribute score of 1,000. This then provides a possible maximum total attribute score of 11,000 each for front and back of the card for a total of 22,000. These scores are then processed by proprietary algorithms to arrive at a single Card Grade with a maximum possible Card Grade of

1000. The numeric values used herein are illustrative but do not limit this disclosure in any way. This disclosure's algorithms can use scales sufficient to capture the accuracy and repeatability of the image-processing and final grades.

The computerized system **100** can utilize numerous image processing tools. The underlying image processing technology required for carrying out the various aspects of the disclosure and variations thereof is readily available in the art. For example, facial recognition technology utilizes a "Subject" photo and scans one or more databases (Image Libraries) to locate the Subject within the Library. In this locator process the purpose is to identify the Subject and to compare the Subject to a Golden Image once retrieved from an image library for the purpose of establishing a probability of a "match".

In one aspect, the computerized system **100** measures light diffraction from an edge or surface defect and measures peaks and valleys on the edge indicating extrusions or indents on the edge relative to a straight line fitted on the edge or as with surface defects with high precision measurement of the degree (length and area) of light diffusion by number of pixels or other area measurement. Mixing Red, Green and Blue to form millions of colors and shades of similar colors creates the color palette from which all colors are derived. The computerized system **100** may, for example, utilize 256 different reds, 256 different blues and 256 different greens (the known color palate) to create the entire color palette of 16,777,216 different colors. With the use of highly sensitive lenses and resolution, individual pixels can be measured and any change in color can be identified and measured. Any scratch or blemish may be identified and measured for length, width, area (in pixels for example) and location on the collectible **116**. Light may be directed at the collectible **116** from above and the computerized system **100** identifies and measures the increase or decrease in the surface of the collectible **116** thus identifying depression in surface, pressing of materials, a wave on the surface, and/or altering of the paper stock within the collectible **116**, etc.

Another example of an image processing routine is an image subtraction, wherein all data points on a Golden Image **117** may be utilized to eliminate all identical data points on the front and back of the collectible **116**. The data that remains on the front or back of the collectible is thereby determined to be one or more defects (a mark or space not on the Golden Image) in the collectible. Image Subtraction may be utilized to determine differences in the collectible from the Golden Image such as but not limited to color (fading, alteration, re-coloring and other alterations; like bleaching of image and/or card, etc.) or scratches, chips, or dents. In similar fashion, image subtraction can also identify existing stains, added color to fill in areas of defect, printing errors, the effects of bleaching, stain removal, the addition of material (i.e., paper stock) or other material and image removal for the purpose of altering the width of the collectible's borders in an attempt to re-center the collectible.

FIGS. **16**A and **16**B illustrate an example of image subtraction. The defect spots **301** on the card of FIG. **16**A are all that remain after image subtraction, as shown in FIG. **16**B. In this manner, the system **100** can determine the number of defects identified on the collectible as compared to the Golden Image. The system **100** may also be configured to measure the individual defects, measure the cumulative total number of defects and/or measure the individual and combined area of the surface covered by the defects.

The system **100** can be configured to calculate through the use of various pixel measurements at high magnification and resolution whether a collectible **116** has been resubmitted for grading by the system **100**, and has either been switched or altered from its initial grading. Any previously graded card can be re-graded and can subsequently be authenticated as the original collectible thus eliminating counterfeiting and alteration. The system **100** may be configured to "fingerprint" each collectible using high-resolution imagery. The images captured by the image acquisition device **102** under the different lighting conditions highlight and uncover the unique physical characteristics and/or defects of each card that is graded by the system **100**. These characteristics and/or defects are unique to each card and are difficult, if not impossible, to replicate. These images are stored on the database **103** and serve as a fingerprint of the graded card based on the physical characteristics and/or defects of the card. The system **100** may store the high-resolution image in a collectible image file and is able to use the "fingerprint" to authenticate a collectible that is in a holder ("Slab") or other grading company's holder if the collectible was put in a slab by another company but graded by the system **100**. In both instances, the collectible need not be removed from the holder ("Slab") to authenticate it. The system **100** is able to store a high-resolution image of a collectible and create a "fingerprint" of the collectible for future authentication purposes of all collectibles graded by the system **100** even if the previously graded collectible remains in its slab. If a person desires, and if the image can be collected under acceptable lighting conditions, it may be possible to use a smart phone camera or other remote digital camera or smart phone app or other computerized application to record an image of the collectible for which authentication is desired. The system **100** may be configured to receive a signal external from the image acquisition device **102** comprising at least one image of the collectible to be authenticated and will identify its stored "fingerprint" image and compare the corners, borders, centering and edges for fiber, pixel and other measurement data that will confirm, at least preliminarily, if the collectible is the authentic collectible or a replacement (substitution) of a previously graded collectible or is a counterfeit of the collectible.

A corner algorithm measures several visual attributes whose combination will yield an accurate estimate of the corner score for each of the card's four corners. The source code serves as the most detailed definition of the image attributes, but we describe here the motivating idea for each:

a. [angle] A line is fit to each of the corner's perpendicular edges, and the nearness to a sharp right angle (90 degrees) produces the corner-shape attribute: the closer to 90 degrees, the higher the score.
b. [residual] This attribute measures how close the edge of the cardstock comes to the mathematical lines that define the corner: the closer, the higher the score.
c. [fill] The extent to which the cardstock is present throughout the mathematically-defined corner: the more that is present, the higher the fill attribute.
d. [fray] The attribute measures the fall-off in the cardstock near the corner: the less fraying there is, and thus the higher the score.

Through the disclosure's proprietary algorithms, those four individual corner attribute scores are then calculated to generate a score for each of the corners and for the four corners as a single corner score of the subject card.

An edge algorithm measures at least three attributes for each of the four edges of the card from a certain distance from the corners, such as 0.75 inches from the corner. This

distance can be adjusted by the system **104**. Each of these three attributes corresponds may be used to identify defects on each of the four edges:

a. [residual] The differences between the actual cardstock edge and the mathematical line that approximates that edge. The area of these "peaks and valleys" is measured: the smaller the area, the higher the value of this residual attribute.

b. [fray] The change in the color of the cardstock as it transitions from the edge toward the interior of the card is also measured: less change indicates that the margin of the card is more pristine and carries a higher value for this fray attribute.

c. [color] In addition, the uniformity of the color across the edge is an important consideration: the more uniform, the better the value of this color edge attribute.

As with corners, the individual edge-score results from a learned relationship among these three attributes, based on knowledge from previously graded cards, predetermined perfect 90 degree angles or perfect straight lines, and/or from accepted and quantified industry standards. Through the disclosure's proprietary algorithms those four individual-edge scores, top, bottom, left and right, are then calculated to generate a score for the edges of the object card.

The outermost vertical and horizontal edges of a card when looked at, from above, at high resolution can show an imperfect edge that may have been subject to various points of indentation and/or expansion (peaks and valleys). These edge imperfections may be the result of improper cutting of the edge, alterations of the edge, pressure from rubber bands, pressure from fingers, pressure from storage methodology or a card being impacted or dropped. Under high magnification and resolution they are unique and constitute a "fingerprint" for the card. The system **100** may be configured to fit a virtual line parallel to the outermost right and left side edges from the top edge of the card to the bottom edge of the card ("Vertical Centering Line" left or right, front or back) or from the left outermost edge of the card to the right outermost edge ("Horizontal Centering Line" top or bottom, front or back). Horizontal Centering Lines and Vertical Centering Lines run parallel to the outermost edge at the precise location determined by a threshold creating a virtual line to be fit through any imperfection, jag, hanging fibers, peaks (expansion), valleys (indents) to meet predetermined thresholds. Thresholds are fixed/preselected in an algorithm and establish what portion of an edge is defined as Peaks and what portion is defined as valleys (troughs). In one aspect, the system **100** may use up to five hundred measurement points along each edge to measure the Peaks and valleys to determine the number of each, their location, the area of each and the area of the surface of the card that is affected. Additionally the system **100** may be configured to determine if the card outside edge has been cut or altered. The cut or altered edge has a different appearance than that of the other edges or of cards from the same series and/or set when compared to the "Golden Image." The high-resolution image would be able to display the inconsistent appearance of the cut or altered edge. This high-resolution image of the peaks and valleys of the edges contribute (with other unique identifiers) to a "fingerprint" of the card that may be retained in the card Image File.

Image(s) and/or text are typically printed on the front and back surface of a card or collectible **116**. The Vertical and Horizontal edges of the image and/or text on the front and/or back (left, right, top and bottom) of a card when looked at from directly above at high resolution will show an imperfect edge of the image and/or text as a result of print error or any aberrations (wandering pixel(s) that stray from the image during the printing process). The system **100** may be configured to establish the vertical and horizontal edge of the image and/or text of a card by fitting a virtual line along the edge of the image and/or text (looking down at the surface of the Subject) from the top of the card to the bottom (vertical image edge) or from the left edge of the image and/or text to the right edge of the image and/or text (horizontal image edge) defined by a threshold permitting that virtual line to be fit through an array of pixels, to meet a predetermined threshold. This process of fitting a virtual line may be identical to the process of fitting a virtual line on the outermost edge for Vertical and Horizontal centering Line.

On occasion, an image may extend to the outermost edge of the card. When this occurs, the Horizontal and Vertical centering Edges may be established at the outermost edge only. Centering is then measured by identifying a specific point on the Golden Image that is in the precise center ("Centering Point") of the Golden Image. That Centering Point is isolated in pixels and placed on the Subject. The system **100** may be configured to utilize high resolution imaging to determine if the Centering Point from the Golden Image is higher or lower (centering top and bottom) and left or right (centering left and right) on the card. This provides the system **100** the necessary data to calculate in Microns or Pixels or other increment what percentage the card image is off-center in any direction and/or that the card may be a possible altered or counterfeit card, as well as a contributor to a fingerprint identification.

When the outermost edge provides a border to the card, image pixel measurement or other image processing methods may be employed to measure the distance between the outer edge of the card and the outer edge of the image, both vertically ("Vertical Centering Lines") and horizontally ("Horizontal Centering Lines"), front and back, as a means of establishing the width of all borders surrounding the image and/or text and thereby measuring the centering of the image and/or text on the Subject, front and back.

Pixel measurement or other image processing methods when used to measure the distance between the outer edge and the peaks and valleys of the card, create an absolute and unique "fingerprint" for that card, thereby permitting the system **100** to guarantee that if a previously graded card is re-examined by the system **100** for authentication, such authentication can be guaranteed and confirmed.

The edges can also be measured using a binary large objects ("blob") analysis, as shown in FIGS. **12**A-**13**. Blob analysis employs mathematical methods to detect regions in a digital image that differ in properties, such as brightness or color, compared to areas surrounding those regions. Informally, a blob is a region of a digital image in which some properties are constant or vary within a prescribed range of values; all the points in a blob can be considered in some sense to be similar to each other. Blob analysis is able to identify, quantify, measure individual defect and cumulative total defects area and report on Subject defects otherwise not visible even with traditional magnification aids.

In one aspect, the computer system **104** utilizes blob analysis in combination with various lighting configurations from above and below and high angle and low angle lighting precisely located relative to the surface of the Subject. Blob analysis, when used as a stand-alone tool measures light diffusion on the edge of a collectible **116**, or on the surface of a collectible **116**, which will identify and assist in measuring otherwise imperceptible cracks, creases, dents,

fraying, chips and scratches. Light sources **114**, for example LED lighting, will illuminate the defects that are typically undetectable by other means. Blob analysis may gather data relating to this light diffusion to quantify and measure the area in which the diffusion occurs. Blob analysis may then utilize pre-determined thresholds so that the light diffusion may be identified and measured for authentication and grading purposes. Blob analysis identifies defects in such high resolution that many defects while noted are too small or inconsequential to be of grading value. Predetermined thresholds may be utilized to determine which collectible **116** data collected by blob analysis will be used to later authenticate the collectible **116** ("Fingerprint") for which purpose no defect is too small or inconsequential. These same thresholds may be utilized to determine which defects and data will be used to grade the collectible **116**. When the data for grading purposes is determined, they can then be applied to create a collectible grade. If any blob analysis defects are below a size considered in grading and therefore not utilized in the collectible grading scheme, they may nevertheless be stored in the database **130** associated with the collectible image file and, for example, remain available for identification and authentication purposes ("fingerprint") in the future.

FIGS. **12**A-B show examples of blob analysis on edges. FIG. **12**A shows an example of blob analysis of a vertical edge. There are 14 blobs **501** totaling 448 Pixels in size. The largest blob is 183 Pixels. The blobs are shown within the box **502**.

FIG. **12**B shows an example of blob analysis of a horizontal edge. There are 11 blobs **501** totaling 234 Pixels. The largest blob measures 44 Pixels.

Blob analysis may be combined with other image processing tools to identify defects on a collectible or card **116**. In the card of FIG. **13**, angle lighting and blob analysis enables the system **104** to determine that the upper right corner **701** has at one point in time been slightly bent (no crease was incurred by the bend but the image retains visible effect from the bend). This combination of image processing enables the system **104** to determine that the bend was in a downward manner. If the bend were in an upward manner, the corner defect would be darker than the surface of the card **116**. Image processing is used to determine the degree of defect in any corner of the card **116** by measuring the area of each corner that does not precisely conform with the Golden image **117** or is not a ninety-degree corner and quantifying that missing area by its number of nonconforming pixels.

As shown in FIG. **13**, the card **116** has a corner which has been bent downward. The bent corner measures 223 pixels. FIG. **5** illustrates a corner analysis for a card **116** having a corner defect in its upper left hand corner **901** (from a front viewing perspective). There is one defect **902** measuring 858 pixels in area. To the right, the figure shows the same corner magnified so that the defect may be seen by the naked eye. In this manner, the system **104** determines that the card **116** has a slightly damaged corner—missing 858 pixels from this area. FIG. **10** illustrates a corner analysis for a card **116** having a badly damaged corner. The system **104** identifies an upper left corner that has three defects. The total area of the three defects is 5,212 pixels. The largest of the three defects measures 5,082 pixels. The right-most figure panel shows a magnified view of the same card with the upper left corner defects are now visible to the naked eye. Note the hanging fibers and the Peaks and Valleys that enable system **104** to "fingerprint" this card and authenticate it at a later date as the card originally graded by the system **104**.

A centering algorithm, as shown in FIG. **4**, can be used to obtain a centering score, based on several component attributes:

a. The margin between the edge of the cardstock and the start of the card image is measured on each of the four sides of the card: the top/bottom ratio is one attribute, e.g., 63.2/36.8 and the left-right ratio is a second attribute, e.g., 40/60.
b. The alignment of the card image relative to the edges of the cardstock is measured and distilled into an angle of rotation for the card image.

An industry-standard mapping of centering-ratios to overall centering-score is then used to find the overall centering-score for the card. For example, horizontal centering lines and horizontal centering edge are determined, and the system **104** can, for example, use up to 100 measurement points along the lines measuring the distance between the lines and resultantly any image slope (slant in the printing of the image on the card) associated with the image on the card. This calculation may be performed on Horizontal Centering Lines and Vertical Centering Lines to determine the width of the border on all sides of the image of the collectible **116**. The system **104** calculation identifies the degree of off-centeredness of the image of the collectible **116** as well as the pixel variance on each border between the largest width and the narrowest width and compares them to the Golden image **117** to confirm they are defects. Thresholds may be applied and grading defects thereby determined. Defects outside the grading thresholds may be stored in the image file in the database **130** for authentication purposes, if needed, at a later date.

FIG. **8** illustrates an example of an image centering analysis according to an aspect of the disclosure. The left margin of this Frank Torre baseball card shown in FIG. **8** is determined to be 42.2414 pixels wide=55.39%; while the right margin is determined to be 34.0168 pixels wide.=44.61%. Therefore, the L/R margin ratio is 55.4/44.6%.

A surface algorithm seeks to give each object card a score based on the condition of the central surface of the card. Specifically, it downgrades this score based on, among other defects such as slope, the following card conditions:

a. Tape, glue, or other materials are affixed to the card **116**, e.g., from prior mounting or accidental contact. In addition, ink, pencil, or other markings can detract from the overall grade of a card.
b. Scratches, creases or missing layers of the image or cardstock can also detract from the surface of the card. Removed staples and pinholes, e.g., from thumbtacks leave punctures in the cardstock.
c. Fading of color of gloss of the image, and/or misprinting errors also reduce the surface score of an object card.

In order to detect the many different types of surface defects, the system **104** compares the images taken under several distinct lighting conditions. These different lighting conditions accentuate the physical condition in the collectible **116** in order to detect the many different types of defects that could be present in a collectible. The computer system **104** compares the images taken under the different lighting conditions, and since the collectible **116** was stationary while the images were taken resulting in substantially aligned images, alignment of features from one image to another is made much easier: template-matching can align the images' features within one pixel—and, many times, to a precision greater than that. Even with no external template (that is, a database image) the difference in images between

those lit from one side of the card and the other will reveal creases and other subtractive defects (pinholes).

In order to detect defects, the card needs to be compared to a template image, or in the absence of a template, portions of the card can be compared directly to other areas from the same image or a similar image, e.g., a different card from the same series. Each of the defects found, if any, would reduce the overall surface score for the card through algorithms consistent with standard card-grading practice.

FIG. **14** shows an example of a blob analysis combined with other image processing algorithms to identify defects in the card. There are 9 measurable areas on a crease line **1101** measuring 838 pixels in total area and 394 pixels of area in the largest crease area. The smallest crease area is 32 pixels. If the threshold for creases were established at greater than 32, the smallest of the blob creases would be stored in the card image file for authentication ("fingerprinting") purposes at a later date, if needed, but the 32 pixel crease would not be utilized in grading this card. However the thresholds are set, the blob analysis may be applied consistently across all cards to give consistent grading of cards.

The system **100** can be configured to employ Optical character recognition ("OCR") to read the image and/or text on a collectible **116**, and convert it into identifiable and readable text. Thus, the system **100** may use OCR or readable text to identify the collectible **116** in order to automatically locate its Golden Image **117** in the Golden Image Library or elsewhere in stored images (i.e., Subject Image File). The converted text can also be used to compile any other text data on a collectible (e.g. team, town, statistics, date, number, manufacturer, country, names, locations, etc.).

The system **100** may alternatively or also be configured to provide for Manual Input of a collectible **116** identifying data should it be a unique collectible or be otherwise unknown within the database **130**. The system **100** may alternatively, or in addition, be configured to use Image Recognition technology known in the art to identify or match the collectible **116** with its corresponding Golden Image **117** file.

The system **100** may be configured to analyze the coloring of the collectible or card **116** and compare it to the Golden Image **117** using RGB (red, green blue) values for its color data. The red, green and blue coloration of each subject image may be evaluated and described as an average value for each color or for all the colors combined. The color data for each color of a collectible is then compared to the Golden Image color data to determine how much the colors of the collectible vary from the colors of the Golden Image. The result is displayed as the "Color Difference" which represents an average difference of the red, green, and blue values and may be stored in computer-accessible computer memory or the database **130**.

The system **100** may be configured to accurately measure the thickness of a card or collectible **116**, for example, with a sensitivity of 0.25 microns, for the purpose of determining: if the card is counterfeit and on paper stock dissimilar from the Golden image **117**; if the card has been "pressed" in an attempt to remove a surface crease; if the card has had one or more corners pressed in an attempt to "press" lifting of corner stock; and, if the card is a previously graded card by the system **104**. For Example, this measurement may be performed using a Confocal Fiber Displacement Sensor which uses LED lighting (with which the imaging device **106** is equipped), without contact with the card, to more precisely measure the thickness than previously available technology such as laser triangulation. Thickness measurement may also be performed by other non-contact methods known in the art, such as terahertz time-domain spectroscopy (see Mousavi et al, *Simultaneous composition and thickness measurement of paper using terahertz time-domain spectroscopy*, Applied Optics, Vol. 48, Issue 33, pp. 6541-6546 (2009)) and multiwavelength THz interferometry (see Nguyen et al., *Optical thickness measurement with multiwavelength THz interferometry*, Optics and Lasers in Engineering, Volume 61, October 2014, Pages 19-22).

The above sections describe how the system arrives at an object-card score for each of four large grading criteria: Centering, Corners, Edge, and Surface (including color and gloss). From those four scores, measured on a 0-1000 scale, say, a single overall score for the card is computed based on the weighting determined by proprietary algorithms and that is standard in the card-grading industry. Because the usual output is provided on a scale from 0 to 10, the system can scale its overall score to that range or any other range selected.

In order to display its processing results to an output device **122**, the system **104** generates a grade report, for example in HTML, creating each score (and all of their component attributes) as quickly as possible, and swapping the actual results for their placeholders as they become available. The use of Javascript and its many libraries, e.g., AJAX, makes that swapping possible. By the end of the analysis, the user has access to all of the attributes, scores, raw scores, and overall score from the system. In addition, the images of the card and grade report for the card is added to the database **130** in order to improve future reasoning about identity or quality of scanned or camera-produced images. In addition, storing the card images in the database **130** enables the system **104** to identify individual instances of cards, for authentication and to facilitate alteration detection and/or counterfeit detection.

FIGS. **4**, **7**, **9**, **10** and **11** provide examples of card grading reports that provide scores of the centering, corners, edges, and surface along with the overall score card grade in FIG. **3**. The Golden image **117** of the card **116** is also provided along with the image of the graded card **116**. The centering analysis and score is displayed in FIG. **7**. The score report for the edges is displayed in FIG. **9**. A score report for the corners is presented in FIG. **4**. A score report for the edges is presented in FIG. **11**, wherein defect areas on the edges are magnified in a box, as shown in FIG. **11**.

With individual instances of scanned cards or collectibles **116** available in the database **130**, the system **104** can use the same techniques described above to solve—or facilitate—authentication of three types:

a. By comparing at least one of the: centering, corner, edge, and/or surface attributes, the system **104** will be able to distinguish different instances of identical cards **116**, e.g., two 1963 Topps Mickey Mantle cards. (See FIGS. **15**A and **15**B). Only the identical card would match a previously graded image and stored instance in all of those attributes closely enough to be considered identical. This contributor to fingerprinting allows for re-identification of a particular collectible.

b. Some of the surface algorithms will be able to flag portions of a card that have been intentionally altered in order to artificially raise its grade. For example, in-painting (color alteration) is a kind of additive surface defect made to cover over another imperfection in a card.

c. The database **130** can store any geometric or other metadata about each card **116**, so that all of the known counterfeit identifiers can be flagged.

The system **104** can comprise a graphical user interface on the output device **122** that allows a user, through customary mouse motions and other input gestures, to specify the locations in a card where the system would check for known discrepancies that would signal a possible counterfeit.

The computerized system **100** creates an image file of the collectible **116** and this file may be stored in the database **130** in remote network-linked computer memory devices, and remain accessible to the computerized system **100** and its customers. The collectible **116** image in the database **130** is also a "fingerprint" of the collectible **116**. In the images stored at the resolution used by the system **100**, the corners and centering are unique and cannot ever be reproduced or counterfeited. The computerized system **100** can measure and capture an image of a corner and/or the centering (width of image borders horizontal and vertical) in such detail that the corner and centering of the image on the collectible or card **116** could always be confirmed in the future. The computerized system **100** measures the edge of each collectible **116** precisely such that the system **100** is able to identify "peaks" and "valleys" on each edge. These peaks and valleys are unique and can never be reproduced or counterfeited. By retaining a high resolution image of the graded collectible **116** a person at any time in the future can send the collectible **116**, or its image via any electronic means, to be authenticated by the system **100** and confirm that the collectible **116** is the same collectible **116** as originally analyzed and graded. A person may also confirm that the collectible **116** of inquiry is not a counterfeit of the original collectible **116**.

At least one advantage of the disclosure is that a graded card or collectible **116** can be authenticated, while the card is either within or removed from its original grading holder, at any time after the initial grading. This provides the added security to ensure that the card being authenticated or regraded is the identical card that was originally graded by the disclosure. The disclosure provides a higher security measure over conventional grading companies, which typically issue a serial number to the card they grade, and/or a certification that the card was graded by them. Conventional grading companies retain a database of the serial numbers for the cards they have graded, but do not retain images of the graded card detailing the physical condition of the card and/or defects at the time the card was graded (a card "fingerprint"). Cards graded under conventional processes can be resubmitted until a desired high grade is obtained. The high grade is obtained due to different humans examining the card. The disclosure will identify that a card has been graded and provide a grade that is identical or consistent with the original grade. The subsequent grade could be lower than the original grade if the condition of the card has changed since it was originally graded. As such, the disclosure prevents the inflation of grades of cards.

Yet another advantage of the disclosure is to further assist the market place in discerning whether a collectible **116** is counterfeit or has been replaced with another collectible. For example, a card that is not a counterfeit, but is not the identical card that was originally graded. The system **100** may maintain ownership data for each collectible **116** and this information may be stored in a correlated manner with the "fingerprint" image, for example in a data structure such as the database **130**. In one aspect, a person may be granted access to the database **130** and confirm that the owner of the collectible **116** is as represented by a third party. This feature permits a buyer of a collectible **116** to confirm that the collectible **116** is authentic and that the seller is the legitimate owner. With each transfer of ownership, a recorded owner and a buyer together will have access to update the ownership record in the database **130**.

In one aspect, the computerized system **100** uses a 1,000 point grading system and converts data collected by image processing to a numeric score and a standardized grade. For example, a 1,000 point max scale may be reduced by thresholds and applied algorithms such that the final score is 815. The 815 may be reported at 81.5 or 8.15 and with the applicable grade for an 815 score (i.e., Perfect, Pristine, Gem Mint, Mint, Mint/Near Mint, Near Mint/Excellent, Excellent/Good, Good/Fair/Poor, etc.). Unlike other grading companies, the computerized system **100** may be configured to provide a grade report comprising a detailed defect report itemizing any deduction in score. The grade report can also comprise a detailed image report that will show an image of the collectible **116** with the location of noted defects identified. The grade report may also be configured to provide a provenance report and authentication report in order to eliminate counterfeiting and fraud (alterations). This 1,000 point grading system also provides an opportunity for collectible **116** owners to differentiate their graded collectibles **116** by score and/or grade report. Thus permitting two collectibles **116** graded with the same standardized grade (Mint/Near Mint for example) to differentiate their collectibles **116** and more precisely determine relative value. Additionally, people who value certain type defects differently may differentiate between collectibles **116** both scored the same (815 and 815, for example) but with different defect attributes. For example, because general eye appeal may be an important component of value for a particular buyer and "beauty" is in the eye of the beholder, one collector may value good corners more than centering or gloss than another does and will be able to discern the grading details to exercise his/her preference.

Aspects of the disclosure may comprise high resolution scanner images or high magnification lenses and/or high-resolution digital cameras to capture images with detail that is imperceptible to the naked eye even using hand held magnifiers, as is currently used in conventional grading. Precise imaging tools may, for example, be utilized to measure thickness, curves, indents, depth, breadth, size, scratches, dents, creases, color, area, length, etc. Precise location and stability of tools in an enclosed and controlled environment are utilized to assure consistency of results. Because the human element is removed, grading of a given collectible **116**, when repeated, will provide within known fixed filters and proprietary algorithms, a statistically valid and similar result, over and over again. Environmental factors are removed from the process such as uncontrolled light, physical movement, distance of lens from Subject, angle, type and configuration of lights and variations in the application of image processing algorithms, as well as fatigue, emotional variance, different eyesight capabilities and different human weighting of defects from different human graders to assure consistency. The computerized system **100** may utilize many image processing algorithms to examine all the criteria necessary for grading. The computerized system **100** may be implemented as a system utilizing a comprehensive examination and analysis of all grading aspects of a collectible **116** for the purpose of grading a given collectible **116** in a consistent manner. A precise and accurate grade must be able to be similarly reproduced on a given collectible **116** when such collectible **116** is tested repeatedly. A precise and accurate grading system must use grading criteria that are standardized and consistently applied to all collectibles **116** if it is to provide

a basis for comparing one collectible to another when the collectibles are not similar, such as a 1952 Topps Mickey Mantle Baseball card with a 1957 Topps Mickey Mantle baseball card.

There is no grading system in use today that is not manual, i.e., based on human judgment. These grading systems lead to errors, inconsistent grades, varying points of grading emphasis by individual graders and re-grading of the same card resulting in different grades. Manual systems may also provide higher grades given to more "important" customers or larger users of the grading service thus depriving the smaller customer from playing on a level playing field. Grading companies state publicly that graders do not know the owner of a collectible **116** but this statement neither assures that a non-grader/supervisor does not know the collectible **116** owner's identity nor that the nongrader/supervisor does not have the means to influence a grade. Further, it is equally important that a card grade may be influenced as it is that the market believes that it could be influenced.

TAG Proof is a card that is identified as virtually perfect and does not have any defects. Similar in concept to a Proof coin issued by the U.S. Mint, the TAG Proof is issued by the manufacture. TAG will go to the manufacture's printing facilities and grade cards as they are printed. TAG will wear gloves; human hands will not touch the cards. As TAG identifies cards that receive a perfect grade (Proof) subject to permitted system variance they will be placed in holders and marked as "Proof". The TAG Proof card can be the standard upon which other cards of the same type are compared against to determine the grade and/or quality.

Although the present disclosure and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the technology of the disclosure as defined by the appended claims. For example, relational terms, such as "above" and "below" are used with respect to a light source or a collectible. Of course, if the light source or collectible is inverted, above becomes below, and vice versa. Additionally, if oriented sideways, above and below may refer to sides of the light source or collectible. Moreover, the scope of the present application is not intended to be limited to the particular configurations of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding configurations described herein may be utilized according to the present disclosure. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the disclosure herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

The various illustrative logical blocks, and modules described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

The steps of a method or algorithm described in connection with the disclosure may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM, flash memory, ROM, EPROM, EEPROM, registers, hard disk, a removable disk, a CD-ROM, solid state storage, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal. In yet other aspects, the processor can be remote to the storage medium and accesses the storage medium through a linked connection.

In one or more exemplary designs, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a general purpose or special purpose computer. By way of example, and not limitation, such computer-readable media can include RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, solid state, or any other medium that can be used to carry or store specified program code means in the form of instructions or data structures and that can be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce

data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

In the present disclosure, the processor may serve as a structure for computer-implemented functions as described herein because the function(s) described in one or more aspects of the present disclosure are coextensive with the processor itself. Further, such a processor may serve as structure for functions that may be achieved by a general purpose computer without special programming, because the coextensive functions include receiving data, storing data, processing data, etc. Further, the present disclosure are removed from the abstract, and do not merely limit the use of an abstract idea to a particular technological environment. The present disclosure expands basic building blocks beyond the mere sum of the parts, at least for the reason that the present disclosure provides faster, more consistent, and more reliable results than obtainable with current methods and devices.

The previous description of the disclosure is provided to enable any person skilled in the art to make or use the disclosure. Various modifications to the disclosure will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other variations without departing from the spirit or scope of the disclosure. Thus, the disclosure is not intended to be limited to the examples and designs described herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

We claim:

1. A computerized system for grading a collectible, comprising:

an image acquisition device, comprising:

a housing defining an internal space;

an imaging device;

at least one light source to illuminate at least part of said internal space; and

a stage within said housing and configured to receive said collectible;

a computer system, comprising:

at least one processor comprising processor-executable computer instructions; and

at least one output device; and

a database comprising a datastore of golden images accessible by said computer system;

wherein said image acquisition device is configured to receive at least one input signal from said computer system, said at least one input signal comprising at least a series of instructions for said imaging device and said at least one light source;

wherein said image acquisition device is configured to transmit at least one output signal to said computer system, wherein said at least one processor applies at least one processing routine to said at least one output signal;

wherein said computer system produces a grade report of said collectible based on the results of said at least one processing routine.

2. The computerized system of claim **1**, wherein said database further comprises information and images of known collectibles, metadata and images of graded collectibles.

3. The computerized system of claim **1**, wherein said golden images comprise images of a plurality of collectibles without any unintended defects.

4. The computerized system of claim **1**, wherein said imaging device is adapted to capture at least one image of said collectible, wherein said at least one image is a high resolution digital image.

5. The computerized system of claim **4**, wherein said imaging device is a digital camera or a scanner.

6. The computerized system of claim **1**, wherein said at least one light source comprises a plurality of light sources adapted to provide a plurality of different lighting conditions, wherein said imaging device is adapted to capture an image of said collectible under each of said different lighting conditions.

7. The computerized system of claim **6**, wherein said at least one input signal from said computer system comprises a series of instructions for said plurality of light sources and said imaging device such that said plurality of light sources provide said different lighting conditions and said imaging device captures an image of said collectible under each of said different lighting conditions.

8. The computerized system of claim **7**, wherein said at least one input signal from said computer system controls the on/off state of each of said plurality of light sources to provide each of said different lighting conditions.

9. The computerized system of claim **7**, wherein said image of said collectible under each of said different lighting conditions is transmitted to said computer system.

10. The computerized system of claim **1**, wherein said at least one output signal transmitted from said image acquisition device to said computer system comprises a plurality of images of said collectible illuminated in a plurality of different lighting conditions, wherein said at least one processor applies said at least one processing routine to said plurality of images with respect to a golden image from said database, said golden image comprising an image of a collectible without any unintended defects.

11. The computerized system of claim **10**, wherein said at least one light source provides said plurality of different lighting conditions in response to said series of instructions from said computer system.

12. The computerized system of claim **10**, wherein said at least one processing routine comprises a comparison routine, wherein said at least one processor of said computer system compares at least one image of said collectible against said database in order to identify said collectible.

13. The computerized system of claim **10**, wherein said at least one processing routine comprises an image subtraction routine, wherein all data points on said golden image are utilized to eliminate all the identical data points on said collectible, wherein remaining data points on said collectible is determined to be one or more defects.

14. The computerized system of claim **10**, wherein said at least one processing routine comprises a corner routine, wherein said at least one processor examines the images of said collectible to determine the quality of the corners.

15. The computerized system of claim **10**, wherein said at least one processing routine comprises an edge routine, wherein said at least one processor examines said images of said collectible to determine the quality of at least one edge of said collectible.

16. The computerized system of claim **10**, wherein said at least one processing routine comprises a centering routine, wherein said at least one processor examines said images of said collectible and measures a margin between an edge of said collectible and a start of a collectible image on said collectible.

17. The computerized system of claim **10**, wherein said at least one processing routine comprises a surface routine,

wherein said at least one processor examines said images of said collectible for subtractive defects, additive discolorations, and quality of color of a surface of said collectible.

18. The computerized system of claim **17**, wherein said subtractive defects comprise a crease or scratch in said collectible that would otherwise not be present, and said additive discolorations comprise a stain or color alteration in said collectible that would otherwise not be present.

19. The computerized system of claim **1**, wherein said imaging device can measure the thickness of said collectible to determine whether said collectible has been altered from its original condition and whether said collectible has been modified to conceal a defect.

20. The computerized system of claim **1**, wherein said grade report comprises a detailed defect report identifying defects on said collectible, a detailed analysis of the centering, corners, edges, surface, and overall score of said collectible.

21. The computerized system of claim **1**, wherein said grade report is stored on said database and accessible for future reference.

22. The computerized system of claim **1**, wherein said results of said at least one processing routine are stored on said database and accessible for future reference.

23. The computerized system of claim **1**, wherein said image of said collectible under each of said different lighting conditions is stored on said database and accessible for future reference.

24. The computerized system of claim **1**, wherein said results of said at least one processing routine define a fingerprint of said collectible, such that said collectible can be authenticated by said fingerprint by said computerized system at any time after said collectible has been examined by said computerized system.

25. The computerized system of claim **1**, wherein said computer system is configured to receive an external input signal from a device external to said computerized system, wherein said external input signal comprises at least one image of a previously graded collectible, wherein said at least one processor applies said at least one processing routine to said at least one image of said previously graded collectible with respect to a known image of said previously graded collectible on said database.

26. The computerized system of claim **25**, wherein said at least one processing routine comprises a comparison routine, wherein said at least one processor compares said at least one image of said previously graded collectible from said external signal against said known image obtained by said computerized system in order to verify that said at least one image of said previously graded collectible from said external input signal is in fact said previously graded collectible graded by said computerized system.

27. The computerized system of claim **25**, wherein said at least one processing routine comprises a comparison routine, wherein said at least one processor compares said at least one image of said previously graded collectible from said external signal against an image of a known counterfeit collectible comprising known counterfeit defects in order to determine whether said known counterfeit defects are on said at least one image of said previously graded collectible from said external signal.

28. The computerized system of claim **25**, wherein said device external to said computerized system comprises a digital camera, a scanner, a smart phone, or a linked computer.

29. The computerized system of claim **1**, wherein said computer system can identify a virtually perfect collectible, wherein said virtually perfect collectible is a proof collectible.

30. A method of grading a collectible, comprising:

capturing at least one image of a collectible under one or more lighting conditions;

transmitting said at least one image to at least one processor;

applying at least one image processing routine onto said at least one image;

retrieving a golden image reference file of said collectible from a database;

identifying each difference between said at least one image of said collectible and said golden image;

quantifying the differences between said at least one image of said collectible and said golden image;

storing a record of quantified differences between said at least one image of said collectible and said golden image in said database;

assigning a numerical value to each of said quantified differences according to a predetermined grading criteria;

calculating a grading score for said collectible based on said numerical values assigned to each difference in said predetermined grading criteria;

producing a grade report based on results of said at least one image processing routine; and

transmitting said grade report to at least one output device.

31. A method of grading a collectible, comprising:

capturing at least one image of a collectible under one or more lighting conditions;

transmitting said at least one image to at least one processor;

applying at least one image processing routine onto said at least one image;

quantifying an amount of missing area of a corner of said image of said collectible versus a golden image;

quantifying an amount of deviation of centering of an collectible image on said collectible versus said golden image;

quantifying image defect differences on a surface of said image of said collectible versus said golden image, wherein said golden image comprises images of a plurality of collectibles without any unintended defects;

producing a grade report based on results of said at least one image processing routine; and

transmitting said grade report to at least one output device.

32. A computerized system for grading a collectible, comprising:

a plurality of image sources comprising at least one image acquisition device and an external image source, said at least one acquisition device comprising:

a housing defining an internal space;

an imaging device;

at least one light source to illuminate at least part of said internal space; and

a stage within said housing and configured to receive said collectible;

a computer system, comprising:

at least one processor comprising processor-executable computer instructions; and

a database comprising a datastore of golden images accessible by said computer system;

wherein each of said image sources is configured to transmit at least one output signal to said computer system, wherein said at least one processor applies at least one processing routine concurrently to each of said at least one output signal;

wherein said computer system produces a grade report for each collectible of said image sources based on the results of said at least one processing routine.

* * * * *